FOUNDRY TRADE JOURNAL

Established 1902

WITH WHICH IS INCORPORATED THE IRON AND STEEL TRADES JOURNAL

Vol. 84 Thursday, April 1, 1948 No. 1648

49, Wellington Street, London, W.C.2
'Grams: "Zacatecas, Rand, London"
'Phone: Temple Bar 3951 (Private Branch Exchange)
PUBLISHED WEEKLY: 21s. per annum (Home and Overseas)

Let's Implement

It appears to us that there is more need for the implementation of existing legislation and reports than for further laws or committee proposals. For instance, the Council of Ironfoundry Associations have produced a realistic report on recruitment and training of youth for the section of the industry they represent. Each body interested in this question—and there are many—should formally adopt the report and endeavour to implement the scheme. Next there is the Garrett report. Any foundry owner desiring to comply with its provisions will find that his major difficulty is selling the idea to the various Government departments. Efforts to separate the fettling shop from the main foundry so as effectively to tackle dust production, and to erect modern washing facilities, have been frustrated in the case of a brand-new foundry existing in the Government's pet development area. Then there is the building—or should it be the re-building?—programme. Here there are projects of all kinds still waiting to be implemented, but progress is impeded because too many people are spending too much time, not merely in thinking out fresh projects, but inventing ways and means for impeding the finishing of those started. One foundry, now happily in production, was held up because its promoter refused to give an undertaking to a Government official that he would not pay more for second-hand material than the controlled price for new. However, if we understand the story rightly, this official was overruled by a "high-up" in another department.

We hear that Mr. Gardner, the secretary of the Amalgamated Union of Foundry Workers, is not quite satisfied as to the accident position in the industry. He believes the incidence is higher than in the heavy industries. By the very nature of conditions, we should imagine this to be correct. In heavy industries, if there be an accident, it is likely to be of a grave character and, therefore, fewer risks are taken. In the foundry industry, there is such a plethora of movement, such a diversity of machinery, that the liability to accident is greater. We have each year followed with care the report of the Factory Inspectorate and we have noted, as was to be expected, that there was an increase during the war and a subsequent decrease. Here is another case where implementation of the existing Factory Acts and Codes of Conduct would be productive of more good than new legislation.

Finally, a representative committee of the whole of the industry has set up a Foundry Information Committee. This has had a remarkably good start. Both the largest and the quite small concerns have expressed their intention to co-operate. Thus, if moulders become famous in sport; if a product could be labelled the largest or smallest or could give a novel service; if orders were received from unheard-of places or those momentarily in the news; or if a foundry receives visits from V.I.P.s, then an effort will be made to publicise such features with the object of letting the world realise that foundries are of importance to the man-in-the-street. This is but a short list of the many things which still require implementation. The excellent work of the pioneers demands such recognition.

We regret that in some copies of last week's issue the printers forgot to remove the title from the previous number and so what should have been captioned "The Rôle of Learned Societies" was christened "The Economic Survey for 1948." Our apologies are also tendered to the Institute of Metals, and especially to its new President, Sir Arthur Smout.

Contents

Let's Implement, 315.—Forthcoming Events, 316.—The Specification and Testing of Cast Iron, 317.—Correspondence, 322.—House Organs, 322.—The Danish Foundry Industry, 323.—Stress-relief Treatment of Iron Castings, 325.—Tributes to Nobel Prizewinners, 329.—Royal Society Elects New Fellows, 329.—Personal, 330.—Gazette, 330.—Allocations of Tin Metal, 331.—Shipyard Workers' Wage Claims, 331.—Limestone Supplies Endangered by Labour Shortage, 331.—United Kingdom Tin Position, 331.—News in Brief, 332.—Industries' Response to Price Cuts, 333.—Contracts Open, 333.—Imports and Exports of Iron and Steel, 334.—Company News, 336.—Raw Material Markets, 338.

Hatfield Memorial Lecture

PROFESSOR ROBERT FRANKLIN MEHL, who is to deliver the Third Hatfield Memorial Lecture, was born in Lancaster, Pa., U.S.A., on March 30, 1898. He received his early training at Franklin and Marshall College, Lancaster, Pa., where he graduated as B.S. in 1919; in 1924 he gained the degree of Ph.D. at Princeton University. Professor Mehl was a Proctor Fellow in Chemistry at Princeton University (1922-1923); he started his professional career as Head of the Department of Chemistry at Juniata College (1923-1925), and followed this with a period as a National Research Fellow at Harvard University (1925-1927). He next took the position of Superintendent of the Division of Physical Metallurgy at the Naval Research Laboratory, Washington, D.C. (1927-1931), inaugurating this division, and then became Assistant Director of the Research Laboratories of the American Rolling Mill Company, Middletown, Ohio. In 1932 he became Director of the Metals Research Laboratory and Professor of Metallurgy at the Carnegie Institute of Technology, Pittsburgh, Pa., and in 1935 was made Head of the Department of Metallurgical Engineering in the same Institute; these positions he continues to hold. Professor Mehl has published about a hundred Papers on the constitution of alloys, crystal structure, radiography, the electron microscope, the properties of forging steels, general metallurgy, theory of age-hardening, heat-treatment of steel, etc. Professor Mehl holds honorary degrees of Franklin and Marshall College (1938), Sao Paulo University (1944) and Stevens Institute of Technology (1944). During the second world war he was an attaché at the U.S. Embassy in London (1945), with the similated rank of Brigadier-General.

The lecture, entitled "The Decomposition of Austenite by Nucleation and Growth Processes," will be given, under the auspices of the Iron and Steel Institute, on May 5, in the Lecture Hall of the Royal Institution of Chartered Surveyors, London, S.W.1.

British Standards Institution

The Monthly Information Sheet for February, 1948, lists amongst "Amendment Slips Issued," PD 750, Amendment No. 3 to B.S. 78:1938, cast-iron pipes (vertically cast) for gas, water and sewage, and amongst "Future Publications," B.S. 1400:1948, copper alloy ingots and castings (7s. 6d.).

What Offers?

A Maltese businessman has written asking us whether any ironfounder would like to join him in establishing a new ironfoundry in the George Cross Island. He is prepared to come to this country to open up negotiations. The Editor will disclose the nature of the proposals on request.

Forthcoming Events

(Secretaries are invited to send in notices of meetings, etc., for inclusion in this column.)

APRIL 6.

Society of the Chemical Industry.

Chemical Engineering Group:—"Recent Developments in Cast Iron," by J. G. Pearce, in the apartments of the Geological Society, Burlington House, London, W.1, at 5.30 p.m.

West Riding Federation of Engineering Societies.

"Ultra High Speed Photography" will be presented by G. A. Jones, M.A., to a joint meeting at the Technical College, Bradford, at 7.30 p.m.

Sheffield Metallurgical Association.

"Precision Casting," by H. Evans, at 198, West Street, Sheffield, at 7 p.m.

APRIL 7.

Institute of British Foundrymen.

East Anglian Section:—Annual General Meeting, followed by "Foundry Inquest—Fault and Cure." At the Lecture Hall, Central Library, Ipswich, at 7.30 p.m.

Institution of Production Engineers.

Nottingham Section:—"Inspection," a lecture at the Victoria Station Hotel, Nottingham, at 7 p.m.

Institution of Works Managers.

Yorkshire Branch:—Visit at 2 p.m. to the works of Prince, Smith & Stells, Limited, Keighley.

APRIL 8.

Iron and Steel Institute.

Symposium on the Peeling of Whiteheart Malleable Cast Iron, at 4, Grosvenor Gardens, London, S.W.1, at 2 p.m.

The Institute of Metals.

London Local Section:—Annual General Meeting at 6 p.m. at 4, Grosvenor Gardens, London, S.W.1, followed at 7 p.m. by an Open Discussion on "The Oxidation of Metals."

APRIL 9.

Institute of British Foundrymen.

Middlesbrough Branch:—Visit (ladies included) to the works of Head, Wrightson and Company, Limited, at 7 p.m., followed by the Annual General Meeting.

APRIL 10.

West Riding of Yorkshire Branch:—W. Anderson and C. S. Johnson, the Joint Winners of the 1946-47 S. W. Wise Memorial Competition, present their Paper at the Technical College, Bradford, at 6.30 p.m.

Newcastle Branch:—Annual General Meeting, followed by a technical film. At the Neville Hall, Westgate Road, Newcastle-upon-Tyne, at 6 p.m.

Prices and Profits

The F.B.I. states that 30 industries and many individual firms have already, within a week, reported on their detailed examination of prices in accordance with the recommendations as set out in the F.B.I. "Report on Prices and Profits." Price reductions have already been decided on in many categories of consumer goods. Price reductions have also been decided on in several groups of industrial goods, including certain classes of engineering components and accessories, clock and piano parts, *pig-iron products*, and engineering tools.

Prices will be held at their present level, in spite of increased costs, by many manufacturers whose products or processes include certain classes of plastics, glass, metallic bedsteads, wall paper, furnishing fabrics, oil seals, printing ink, ball and roller bearings, ball clay, bleaching and finishing, *steel and brass founding*, cleaning, electrical and general engineering components, wool textiles, razor blades, industrial plant, *iron castings*, chain drives, carpet sweepers and felt hats.

The Specification and Testing of Cast Iron*

How B.S. Specifications for Cast Iron are formulated

By Arthur B. Everest, Ph.D., F.I.M.

INTRODUCTION

Any who have had the privilege of attending meetings of the various foundry organisations abroad will have been struck by the number of Papers given on the subject of the testing and specification of cast iron. These Papers are generally of a detailed type, discussing the relative merits of small versus large test bars; statistical analysis of test results; relationship between various tests, and attempts to develop a quality index for cast iron. Many of these Papers lead to animated discussions, often on a highly technical level.

In Great Britain there is a tendency to take specifications for granted, and it probably rarely occurs to the average foundryman that he personally has an indirect responsibility in the framing of specifications, or to what extent the Technical Council of the Institute of British foundrymen is involved in work, through its sub-committees, in the framing of specifications and in co-operating in the work of the British Standards Institution.

In presenting this Paper, the Author is aiming to show how close a tie-up there is between foundry progress and specifications and to tell members something of the vast amount of work carried on behind the scenes by their representatives. His aim is also to emphasise to what extent the interests of the foundrymen are looked after by those concerned with the specifications for cast iron and iron castings.

What is a Specification?

A specification is a yard-stick whereby the quality of a product may be judged. It may have been drawn up by the manufacturer, or by the user, indicating on the one hand the quality of product available, and on the other hand the needs of the user in his general production.

In the past, any manufacturer who could turn out a product which he considered superior to that made by his neighbour, attempted to gain advantage by giving his product perhaps a fancy name, or by giving publicity to the special properties which it showed. On the other hand, any user of iron castings, if his business were big enough, was able to issue demands on the manufacturer setting out his requirements in detail. Thus, in the early days, such large users as the Service Departments, Public Works Authorities, etc., issued their own specifications. These specifications may have been based on purely design considerations, or sometimes they were based on analysis and tests on the properties of a casting which had been proved by experience to meet requirements.

*Paper presented to the London Branch of the Institute of British Foundrymen.

Present Position

To-day it is recognised to be to everyone's advantage to have specifications nationalised. During wartime it was found that the placing of large open contracts was often hindered by the use of trade names or private specifications put forward by individual producers, and the tendency developed more and more to cover products by national specifications which could be issued to the trade as a whole.

In the case of cast iron, as foundrymen became able to produce castings under controlled conditions so that the properties could be consistently reached, it was recognised that it was of mutual advantage to both manufacturer and user to cover the product with a national specification. The advantages of such a course are obvious. (1) It enables progressive foundries to have their capabilities fully recognised. (2) The purchaser or user knows just what he is getting. The specifications sets a standard of quality or Hall-mark on the product. (3) Engineers and designers may make fullest use of the new materials available, and (4) specifications go all round the world, and can be regarded as a most authoritative form of national advertising. It is, therefore, a matter of international prestige that the specifications should be up to date and fully representative of the capabilities of the industry.

It is clear from what has been said above that specifications must be agreed between both manufacturer and user. It is the basis of any specification that it must be acceptable to these two primary parties to any contract.

The Drafting of a Specification

A handbook issued by the B.S.I.[1] makes it clear that the Institution does not within itself initiate new standards, but is essentially the instrument whereby new standards are agreed as the result of free discussion between all concerned. The need for a new standard may arise either within the industries concerned, or the distributing trades, or the users. Any of these can communicate its desire for a Standard to the Institution and call for action.

The Institution calls a conference of all parties interested, including Government Departments, industry, distributors, users and professional bodies. If a meeting of all these confirms that a Standard is desirable, a representative drafting Committee is formed with secretariat provided by the Institution. This Committee co-operates with any outside committee concerned with the technical details of the specification. After an agreed draft has been prepared, this is then distributed in appropriate form to all bodies in the country who may be involved in the use of this

Specification and Testing of Cast Iron

specification, and for a period of at least three months it is open to comment and criticism. Any points raised are referred back to the drafting Committee and the draft suitably modified. When all outstanding points are settled, the draft specification is printed in proof form and submitted for approval to the appropriate industry Standards Committee of the Institution. When passed by them it is issued as a British Standard. Finally each standard is brought up for review at least once every five years after it has been put into force.

Specifications for Cast Iron

A fundamental problem in the specification position for cast iron is to decide whether it is the material, *i.e.*, cast iron itself, or the finished castings which are subject to specification. Actually, the British Standards adequately cover both of these. A study of the list of existing Standards for iron castings shows they can be divided broadly into two classes. First, general specifications covering grey iron castings and including high duty iron castings, and also specifications for malleable iron castings. Secondly, specifications for finished products, for which the B.S.I. have specifications covering pipes, pipe fittings, manhole covers, gully gratings and frames, boilers, air-bricks, steam jacketed pans, street lighting columns, surface plates and tables, straight edges, gears and gear blanks and the like.

General Grey Iron Castings

From the foundryman's point of view, the main interest attaches to the specifications covering general grey iron castings, as such specifications are, as it were, umbrella specifications covering engineering components of all types. Further, such specifications are a true mirror of progress of foundry development, and from this point of view their representatives on the Technical Council are keen to see that they are kept up to date.

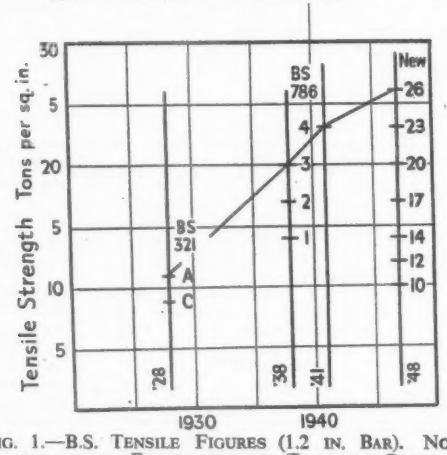


FIG. 1.—B.S. TENSILE FIGURES (1.2 IN. BAR). NOTE HOW THESE FIGURES REFLECT TECHNICAL PROGRESS IN THE FOUNDRY.

The specification for general grey iron castings is primarily a specification covering the quality of the metal used. Careful consideration has, of course, been given in the past to the tests which can be applied to cast iron in order to give a true assessment of its properties, and the practice has been built up over a number of years of using the tensile test as the primary index of quality. In the early days, perhaps more prominence was given to the transverse test, this being, no doubt, a survival of the times when cast iron was used more extensively for beams, girders, etc., in mechanical engineering construction. It has been increasingly recognised, however, that it is difficult to give a true interpretation of the results obtained by this test, and if it were not for the fact that some of the large user bodies still attach importance to this test, it would probably now have been abandoned.

Accepting the tensile test as the index of quality, it is interesting to recall the way the general iron specifications reflect progress over the past twenty years or so (Fig. 1). Up to 1928 the only specifications were those issued by separate bodies, such as the Admiralty and other large users. In 1928, B.S.321 was issued, this having been prepared by a committee on which I.B.F. members took a prominent part. This specification covered two grades of cast iron only, namely grade C. with a tensile strength of 9 tons per sq. in., and grade A. with 11 tons.*

By the middle 1930's, so much progress had been made in ironfoundry technique as a result of use of alloys, a better technical understanding of iron foundry metallurgy, and improved melting furnaces, that steps were put in hand to prepare fresh specifications covering what were then generally called high-duty iron castings. As a result, B.S.786 was issued in 1938, covering three new grades of iron with strengths of 14, 17 and 20 tons per sq. in. respectively. In the early days of the war, interest was intensified in the use of the newer high-duty types of cast iron for munitions production and for replacement of steel and other metals in short supply for the construction of machine tools, etc. Foundry progress was abreast of these demands, and it was found possible in 1941 to issue an addition to B.S.786 in the form of a new grade with 23 tons tensile.

At the end of the war it was felt by the Technical Council and by others that the specification position for cast iron was untidy and needed clearing up sooner or later, and it was felt that the sooner the better. It was recognised that by this date it was not in the best interests of foundry development to refer to the 14 ton tensile iron as being high duty. The use of two specifications with different systems of grading was felt undesirable. Again, trouble had been experienced with certain details of the specifications, as for example impracticability of some of the sizes of screwed-end test bars, and foundry progress had continued so that it was felt that a further grade of cast iron could usefully be included, whilst provision should be made

*Throughout this Paper the strength figures quoted are those for the 1.2 in. diameter bar.

in the specification for additional grades as they become available.

The New Specification

In June, 1945, the Institute's Technical Council formed a new sub-committee—T.S.16—to review the position. This Committee met and considered the above points. In November, 1945, the British Standards Committee—I.S.E./35—also resolved at a meeting that action was required to tidy up the two specifications for iron castings. They were advised of the action already in hand by the Institute, and consequently a drafting Committee—I.S.E.35/2—was formed and adjourned for report from Committee T.S.16.

The Institute's Committee had a large number of meetings and a number of detailed points were considered by correspondence. This Committee had to settle such points as suitable figures for the new grades of iron; revising the transverse and deflection figures in the specification to match with the tensile figures. The bar sizes corresponding to given sections of castings were considered from the point of view of possible revision. Some discussion on the Committee took place as to whether on one grade of iron the properties should be scaled down in respect of size of test bar, or whether the U.S. practice of quoting a constant strength for all sizes of bar in one grade of iron should be adopted. The Committee finally decided that in the interests of all foundrymen a compromise should be adopted whereby some scaling down should be established, in order to make approximately equivalent foundry practice and material cost apply for one grade of iron whatever the size of casting.

Suitable clauses emphasising the fact that the higher duty irons cost more to produce, and warning clauses that some of the high strength irons were not perhaps readily adopted for thin section castings were prepared. The detailed draft as agreed by T.S.16 was then referred to the B.S. drafting Committee. Here it was scrutinised and discussed at length by the committee representing Government Departments, large users, large contractors such as Lloyds, the Admiralty, the Crown Agents for the Colonies and by Associations such as the Automobile Iron Founders and by the B.C.I.R.A. All the more controversial points were discussed at length until agreement in principle was reached, and finally agreement as to the precise wording.

During these discussions the Institute's representatives had in mind the interests of the foundrymen. To mention one or two points, the view of the Institute was put forward that cast-on test bars were not necessary and that the foundryman should be given the greatest possible freedom in selecting the chemical analyses used. It was emphasised that the separately-cast test bars gave a true measure of quality of the iron used, but no guarantee could be entered into that such bars actually represented the strength of the castings. Points of detail with regard to the acceptance clauses, contractual clauses, facilities for inspection, etc., were all dealt with.

Many of these points were referred backwards and forwards between the committees of British Standards and the Institute until ultimately agreement was reached. The agreed draft was then submitted to the senior committee—I.S.E./35—where once again it was considered and was finally agreed as suitable to be circularised to industry for comment and consideration. For three months the draft was before Government Departments, industrial firms and all interested bodies, and comments were submitted to B.S.I. These comments once again were referred back to the appropriate committees, and a short time ago the final draft was agreed upon.

Following the usual practice, the draft was prepared in proof form and is now to be submitted to the Iron and Steel Industry Standards Committee concerned for their approval of the issue of the specification as an official British standard. This is where the matter now stands, but it is hoped that the new standard entitled "Grey Iron Castings" will be published within the next two or three months. (It should be noted by the reader that until that time arrives this new standard is *not* available.)

Fig. 1 shows in diagrammatic form the progressive development during the last 20 years or so, and is a truly remarkable record of the technical progress made in cast iron over that period of time. It should be noted that in the new specification a grading system has been adopted in which the strength of the 1.2 in. diam. bars has been used as the designation of the new grades.

Fig. 2 shows the relationship adopted between strength and bar size. As already mentioned, according to the American principle a constant strength would have been adopted for all sizes of bar in each grade. It is emphasised that in the British specification the curves as shown do not indicate the strengths which would be obtained by one mix cast into the bar sizes

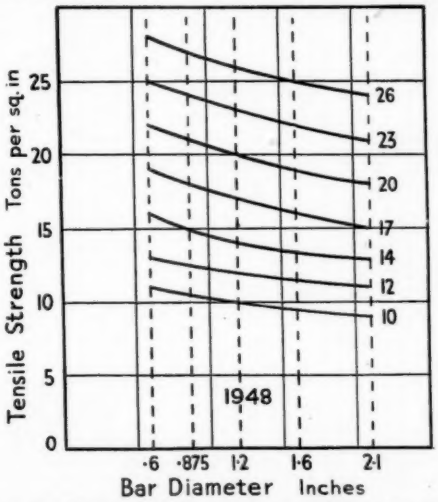


FIG. 2.—TENSILE STRENGTH FIGURES FOR BARS OF VARYING SIZES IN THE NEW BRITISH STANDARD.

D

Specification and Testing of Cast Iron

shown, and it is essentially a compromise arrived at in the best interests of the foundrymen.

Casting of Test Bars

It is, of course, obvious from study of the specification policy of grey cast iron that everything depends on the provision of test bars which are truly representative of the metal. It should be noted that in the U.S. and several European countries it is the practice to incorporate in a general cast iron specification a recommended method for casting the bars, but once again it has been agreed in this country to leave the foundryman a free hand, it clearly being in his own interests to cast test bars in such a manner that they give the best properties truly representative of the metal. This matter received the attention of the Technical Council some years ago when Committee T.S.4 drew up a report in which it was recommended that the test bars required should be cast on end, and gave suggested methods of running the bars in moulds of various types.[3]

Other Properties

It has been emphasised that the basic property covered by the specifications is the tensile strength, whilst transverse strength is also included, and transverse deflection. Consideration has been given to the possibility of including other properties such as shock resistance, hardness, etc. A study of cast-iron metallurgy emphasises that these other properties are not directly related, and it has been found impossible in a general specification to combine them. The present position is that such other properties as hardness and impact are covered by separate specifications. Particular interest attaches to the impact specification which was prepared during the war, primarily by a

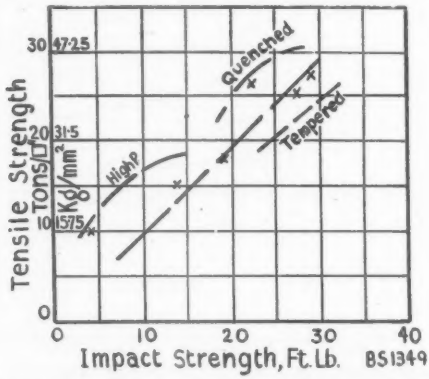


FIG. 3.—RELATIONSHIP BETWEEN TENSILE STRENGTH AND IMPACT, SHOWING EFFECT OF PHOSPHORUS AND HEAT TREATMENT.

committee under the Ministry of Supply, but on which the Institute's technical members were active. The new impact specification, B.S. 1349, is now becoming increasingly known and adopted as a measure of the shock resistance of high-duty cast iron.

The Ministry of Supply Committee concerned also took up work which had been put in hand in the early days of the Technical Council in endeavouring to prepare authoritative data on cast iron covering such lesser used properties as compressive strength, elastic modulus and fatigue strength, and physical properties such as specific gravity, specific heat, etc., and general information on heat-treatment.

The compilation of data prepared by the Ministry of Supply Committee was adopted by the British Standards Institution and issued as their Standard 991. Whilst this standard is regarded as a first attempt to supply the engineer and designer with data of this sort, it should be mentioned that the original authors are far from satisfied with it, and that the issue of the new specification for cast iron will provide an opportunity for general revision and overhaul of these data. This will again give the technical representatives more work.

This data book on cast iron discusses the general properties of iron castings, but points out the fact that inter-relationship between properties is not easily established. The Author feels that a useful index of quality for all cast iron can be based on tensile strength plus shock resistance, but the diagram, Fig. 3, will show at once that no simple relationship exists. The main difficulty is the embrittling effect of phosphorus in cast iron, and if, for example in Fig. 3, reference is made to a tensile strength of about 12 tons per sq. in., it will be seen that the impact can vary from about 4 to 12 ft.-lb., according to phosphorus content. Again, it will be seen that heat-treatment can materially alter the relationship between impact and tensile strength. These considerations are shown in a different form in Fig. 4, in which it will be seen that in one grade of iron an initial increase in phosphorus has, in fact, the effect of raising tensile strength, whilst at the same time it is responsible for a most marked decrease in shock resistance.

With regard to other properties, it is becoming realised that improved foundry techniques and the use of alloys have a marked effect in upsetting preconceived ideas. Thus, for example, the old idea that hardness could be accepted as the index of machinability no longer holds. Alloy irons with hardnesses as low as 160 Brinell can easily be made, which are almost unmachinable owing to their pronounced work-hardening characteristics. On the other hand, grey cast iron of the highest quality will often show hardness approaching 300 Brinell and will prove readily machinable by ordinary methods.

All this points to the fact that each case must be considered on its merits, and any specification for a particular component to be complete will have to provide for any special requirements involved. This is recognised in the new British standard by the inclusion of a clause which allows additional tests, but

which has the definite safeguard that such tests must be agreed between the manufacturer and user. This provision also applies to other details of manufacture, such as, for example, the inclusion of special items in the chemical analysis, or such special technique as heat-treatment.

Product Specifications

Reference has already been made to the existence of a number of specifications covering specialised products. It is the policy of the B.S.I. and of the Institute's representatives to cover the material used for cast-iron products by reference to the general iron specifications. The specifications covering products are generally confined to dimensional considerations and to tests on the actual product. In the case of pipes, boilers, steam-jacketed pans, etc., such tests clearly include appropriate pressure tests. Reference could be made to a relatively new specification covering cast iron street-lighting columns (B.S. 1249), which can be taken as typical. In this case the material is covered by reference to B.S. 321, such a reference covering not only grade of iron to be used, but the usual inspection clauses covering general soundness, accuracy and finish of the castings. The general specification also covers machining by ordinary methods. The particular specification has, in addition, clauses covering testing of the finished article in the form of a deflection test, when a given bending load is applied at the top of the post while the bottom is firmly held.

When these product specifications come up for revision, the foundrymen's interests are watched as before, and a gradual process of modification and incorporation of the general principles discussed in this paper is applied. Such activity arises not only in connection with the specifications listed, but in other cases where ironfounders might be involved. An example is in the specification recently published for silicon-iron castings.

The International Position

The activities of the Technical Council in relation to specifications do not end with the British position. For some years past a body known as the International Committee on Methods of Testing Cast Iron has been in existence to watch the specification position in the international sphere. This Committee has done a great deal of work in co-ordinating specifications between countries and in the preparation of papers considering specification details from both users' and producers' points of view. At the present time, Dr. J. E. Hurst is President and Mr. T. Makemson is Secretary of the International Committee. Other representatives of the B.S.I. and British Cast Iron Research Association also serve on this Committee.

Possible New Specifications

The British standards provide an authoritative channel for the dissemination of data on cast iron. A new activity of the Technical Council is a study of the conditions under which reclamation of iron castings by welding can be accepted. This work is regarded of vital importance in these days of shortages of fuel and labour. The Committee appointed by the Technical Council for this work is aiming to prepare a code of practice acceptable to all parties concerned. If they are successful in their efforts to overcome the main difficulties involved, it is thought that such a code of practice could be given an official status if issued by the British Standards. This work is only just in hand, and it is too early yet to say whether the efforts of the Committee concerned will be sufficiently successful ultimately to achieve this desired end.

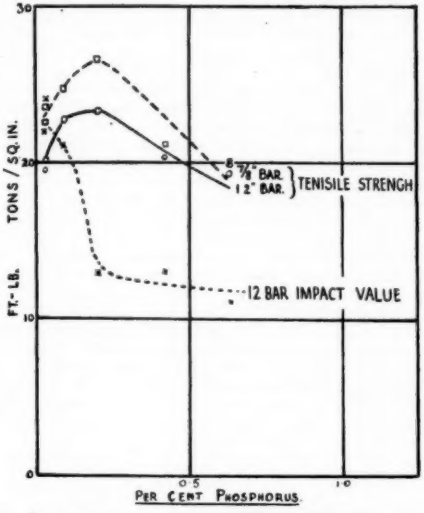


FIG. 4.—EFFECT OF PHOSPHORUS ON MECHANICAL PROPERTIES OF GRADE 20 IRON.

Conclusion

Consideration of problems in connection with the specification and testing of cast iron and cast-iron products occupies a not inconsiderable amount of time and activity of the members of the Technical Council of the Institute. Similar activities are continuously in hand in connection with steel and non-ferrous alloys. This work for the most part takes place behind the scenes, and in concluding this paper the author would like to emphasise that the Technical Council and the British Standards Institution have both expressed the opinion that it would be useful for foundrymen and others to hear something of the work carried out in this field. There are, of course, many controversial points involved, and which for very obvious reasons have been omitted from this paper, but it is hoped that the intention of focusing the spotlight on this one activity of the Technical Council has been achieved.

REFERENCES.

[1] "British Standardisation and Industrial Progress."
[2] Tentative Recommended Methods for Casting Cast-iron Test Bars, Proc. I.B.F., Vol. 38, 1944-45, p. A. 136.

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

LENGTHENING GUNMETAL SPINDLE

To the Editor of THE FOUNDRY TRADE JOURNAL

SIR,—I have read with interest the gunmetal burning-on article by Mr. Morse, and believe this can be reduced to a simple and more economical operation by using a run-off hole at right angles to the burn, as is shown in Fig. 1 (L.H.S.).

A piece of core is trimmed to suit, and this fixed at the burning-on point during the ramming up, which, in this case, could be done in a riser pot. A small piece is broken or cut out where the run-off will come. A tapered hole through the core into the well is made and, during the pour while the metal is pasty, the hole is plugged with the usual bott-stick, as shown in the sketch. This would show a considerable saving of metal over the almost vertical fountain run-off shown in Mr. Morse's article.

Would burning-on be the best for such a simple casting as shown, where wood pieces have to be made to suit as stated? Burning-on is usually resorted to on difficult and sometimes expensive castings, where pattern charges and other considerations merit the risk.

For such a plain casting, a length of correct diameter round core (from the extruder), and a piece of larger diameter core stuck on the end, would provide a "sand pattern" good enough for a single casting. The whole casting could thus be re-made in one piece by the usual routine production, cutting out the risk of a poor "knit," and the shaft would be truly parallel and homogeneous. This latter method is also shown in Fig. 1 (R.H.S.).—Yours, etc.,

J.T.

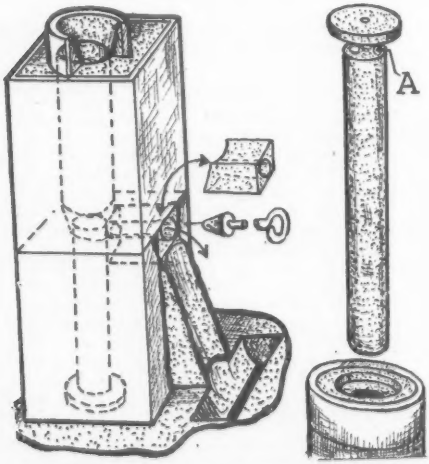


FIG. 1.—(L.H.S.) ALTERNATIVE METHOD OF LENGTHENING G.M. SPINDLE. (R.H.S.) A NEW CORE-SAND PATTERN FOR THE WHOLE SPINDLE.

House Organs

Steel Horizons, Vol. 10, No. 1

Published by the Allegheny Ludlum Steel Corporation, Pittsburgh, Pa., U.S.A.

If any of our readers can get the publishers of this remarkable house organ to add their names to the mailing list, they can be assured of receiving periodically a feast of colour artistically presented and a lesson in lay-out well in advance of most trade publications. Moreover, the letter-press usually contains something really novel. In this issue it is the cooking of steaks by radar in 30 seconds, or fried eggs in 12 seconds. There is a high-grade technical article on the magnetic permeability of nickel-iron alloys.

Sif-Tips. Spring Issue, 1948. Published by Suffolk Iron Foundry (1920), Limited, Stowmarket. Price 6d.

This issue carries a new cover and comment is invited. At a first glance it is very good, but it could have been improved by leaving out the concentric rays, and giving a correlated form to the three insets. Moreover, "Will" should gaze into, not out of, the page. The contents of this issue include articles on the welding of malleable, aluminium brazing, the mending by welding of a 2-ton press arm, and the reclaiming of plough shares by welding. In the case of the first article, there is insufficient differentiation of the properties of blackheart and whiteheart as related to welding.

Book Review

The Electricity Supply Acts. By James W. Chant. Published by Stevens & Sons, Limited, 119, Chancery Lane, London, W.C.2. Price 25s.

On the vesting date for the 1947 Electricity Act, those whose activities include the negotiation of new installations of electric supply or modifications to the existing conditions will have to re-learn their catechism, for much of the old order is changed. This work of reference has been prepared with the object of supplying a convenient means of obtaining reliable information on the new order of things. Wisely, the whole of 1947 Act has been included, even though it takes up 128 pages out of 262. The historical survey, which precedes the book proper, is extremely interesting, for it is difficult to realise that the industry is only about 66 years old. When electricity becomes a state monopoly, the Central Board and the Area Boards will consist to an overwhelming extent of persons appointed by the Minister. This, to our mind, seems a little un-democratic, and as an alternative the system organised by the British Standards Institution, wherein producer and consumer are equally represented, has much to recommend it. Much of the wording of this Act, like all other Acts, is to the lay mind, awkward and difficult to assimilate. However, to know where they stand, the important users must "wade" through it.

The Danish Foundry Industry

A survey which discloses novel developments

*By Ove Hoff**

History

The Danish foundry industry is comparatively new; it began in the last decades of the 18th century, when an Englishman, Mr. Potter, obtained a Royal Concession for creating and operating an iron foundry in Copenhagen (1769). That there were no ironfoundries in Denmark until that time was due to the fact that Norway in those days was a part of the Danish monarchy, and it was the Norwegian iron works which furnished Denmark with castings—especially for the Royal navy and army—and also with stoves and the like. However, when Norway was lost after the Napoleonic war, and Denmark had herself recovered after the great financial crisis which followed the war, the foundry industry flourished all over the country to meet the increasing demand for all sorts of castings. Furthermore, as the middle of the 19th century was the period in which the great agricultural developments took place, the demand for machines and castings to make machines was rapidly increasing.

To-day the number of grey iron foundries in Denmark exceeds one hundred, with a total annual production of about 100,000 tons of finished castings. In addition, there are five steel, two malleable (which are also grey-iron makers), and about 150 to 200 brass and bronze foundries, most of them quite small. The number of moulders, including hand moulders, machine moulders (unskilled) and male core makers, is about 2,500.

A Circular Foundry

The principal foundry city is Copenhagen with about 20 iron foundries, one steel foundry and a large number of brass foundries. Among the Copenhagen foundries is the iron and steel foundry of Burmeister & Wain. This is the largest foundry concern, the iron foundry (in a circular building, 260 ft. dia.) has an annual capacity of 20,000 tons of castings, whilst the steel foundry has a production of about 5,000 tons. They melt about 20,000 tons of steel per annum in two 30-ton basic oil-fired open-hearth furnaces, the balance being cast into ingots for the forge. The other foundries are scattered all over the country, so that most cities have at least one.

As in most parts of the world, the cupola is the principal melting medium for the grey-iron foundries, and only a few electric furnaces and two or three rotary furnaces are in use. Two foundries have Héroult furnaces; two or three have high-frequency furnaces and one foundry uses a Birlec "Detroit" rocking-arc furnace. One of the steel foundries operates a couple of 1,000-kg. (1-ton) Asea high-frequency furnaces, especially for alloyed steel (manganese steel, etc.), the same foundry has two 5-ton open-hearth gas-fired furnaces. Two of the steel foundries have Tropenas converters and one a Héroult furnace and an open hearth. Of the two malleable foundries, one melts in a cupola, the other uses the duplex cupola-rotary furnace process. Both are making blackheart malleable, but their annual production is only 600 to 800 tons each.

Status of Danish Foundries

When a comparison with the foundries of Sweden, Norway, Belgium, France and Great Britain is made, it is the Author's impression that Danish foundries are of much the same calibre. There are, of course, some very old-fashioned foundries, yet most of them are rather well equipped with moulding machines, compressed air, sand blast, etc. However, as most of the units are small, only one true mechanisation scheme has been adopted so far, and that by *Forenede Jernstöberier* (United Ironfounders) at *Frederiksværk*. This foundry has a mechanised department with ten Nicholls machines served by roller conveyors, etc., the whole plant having been furnished by Georges Fischer, of Switzerland.

Amongst the grey iron foundries, only Burmeister & Wain has a production exceeding 10,000 tons per annum. The other foundries, classified according to their output, are as follow:—

Annual production:				
Up to 200 tons	..	20 foundries		
200 to 500	„	..	36	„
500 „ 1,000	„	..	26	„
1,000 „ 2,500	„	..	18	„
2,500 „ 5,000	„	..	6	„
5,000 „ 10,000	„	..	2	„
Over 10,000	„	..	1 foundry	

Personnel

The Author believes that the ability of the skilled moulders, foremen and technical men is fairly high. Before the 1914 war a large number of Danish moulders went abroad and worked for some years in Germany, Belgium, Switzerland, or even went as far as Italy or France, but they seldom found their way to England. Besides this, nearly all of the elderly foundry foremen (who are in fact foundry superintendents) have worked for two or three years abroad as young journeymen. In the years between the two wars, it was almost impossible to get a job abroad, but during the last two years several Danish moulders have been working in Sweden.

Apprenticeship lasts four years, and in three of these, the apprentice must follow the courses at the municipal technical schools for three evenings a week during the six winter months. After the apprenticeship a further approved course is obligatory. The skilled moulders earn about four crowns per hour including

* The author is the Director of the *Danske Jernstöberiers Stöberikonsultation Teknologisk Institut, Büllowsvej* 34 Copenhagen.

The Danish Foundry Industry

bonuses, this figure being the average for all hand moulders in Copenhagen during a 12 weeks' period (a crown is worth very nearly one shilling). Some of these men work as machine moulders, but their employment is not obligatory, and the foundries are allowed to take unskilled labour for such work.

As in most other countries, there has been no unemployment in the foundry industry since the war, and to-day there is a definite shortage of skilled moulders. The number of apprentices has been decreasing during the last few years and there seems to be no reason to expect that the situation will change.

A New Process

The supply of raw materials is difficult. Denmark has no special coking plants—only the municipal gasworks, which are not equipped to make a suitable quality of coke. The main source of supply is, and has always been, Germany. The supply of pig iron is very limited, and the average percentage of pig iron in the charges does not exceed 35; many foundries only use 25 to 30 per cent. De-sulphurisation is seldom used, as the shortage of soda ash is acute. A brighter side of the picture is the fact that the well-known firm, F. L. Smidth & Company, which builds machines for Portland cement plants and also complete installations, and which has some large cement factories in Denmark, has adopted a new method, by which they use an iron-containing mixture in the rotating cement furnaces. By means of this they manufacture pig-iron as a by-product, together with the cement. This process was started on an experimental scale in 1938, but during the war, when the pig-iron shortage was increasing, the method was developed and to-day it is the cement which has become the by-product and the pig-iron the main factor. The iron is introduced in the wet clay-limestone mixture partly as pyrite ash (the pyrite is first used for the fabrication of suphuric acid), partly as Danish ore ($FeCO_3$), together with a comparatively large percentage of borings, etc. The furnace being basic, there is no trouble with sulphur. The virgin iron from the cement furnace has about 4 to 4.5 per cent. carbon, and is very low in silicon and sulphur. A typical composition is the following:—Carbon, 4.51; silicon, 0.01; manganese, 1.01; phosphorus, 0.07; and sulphur, less than 0.01 per cent.

This iron is transported to a rotary furnace, where steel is added to reduce the carbon content and silicon also is added. The firm make hematite types and foundry types, the latter with about 0.8 per cent. P. Typical examples of Danish "cement" hematite and manganese iron are given in Table I.

TABLE I.—*Percentage Composition of Typical Examples of Danish "Cement" Hematite and Manganese Irons.*

	Carbon.	Silicon.	Manganese.	Phosphorus.	Sulphur.
Hematite (1) ..	3.83	2.47	0.96	0.10	less than 0.01
Hematite (2) ..	3.55	3.46	0.84	0.13	less than 0.01
Manganese Iron	5.03	0.14	4.11	0.27	less than 0.01

The capacity of the plant is about 20,000 tons of pig-iron per annum, and this has been an extremely valuable contribution to the pig-iron supply for the Danish foundries during the last few years. The plant is situated in the city of Aalborg in Northern Jutland.

Organisation of the Industry

The ironfounders are organised by the *Foreningen af danske Jernstöberier* (the Association of Danish ironfounders), which has about 75 foundries as members; the rest, who are not members, are only smaller and less important foundries. The only technical association is the *Dansk Stöbemesterforbund* (Institute of Danish foundrymasters or foremen) the term *Stöbemester* is exactly the same as the German *Giessereimeister*). Both the foundry managers and the foremen belong to this institute, but it is conducted by the "masters," and moulders or students are not admitted. During the last few months a "*Stöberiingeniörernes Klub*" (the foundry managers' club) has been formed, with only 16 members, among whom are the executive of the most important foundries. This is, however, a mere experiment; the club only began in November, 1947. To become a member, the applicant must have held a leading position as a foundry executive for at least five years (manager or superintendent). The foundrymasters institute and the association of ironfounders co-operate in the production of the Danish foundry journal and "*Stöberiet*," a monthly review.

Research and Training

The *Stöberikönsultationen, Forsögsstöberiet og Stöbemesterskolen*, that is, the research, consulting and educational organisations of the Danish foundry, are of the following character:—

Danske Jernstöberiers Stöberikonsultation (the Danish ironfoundries' consulting institution), which is 25 years old. In the beginning it only consisted of a foundry manager, who devoted his evenings to answering questions, and a small laboratory, where the founders could get their samples analysed. To-day there is a comparatively large and modern laboratory, fitted with the necessary instruments for chemical analyses of metals, sand, refractories, slag and fuel, with sand-testing apparatus, a microscope and a combined transverse stress and Brinell hardness tester. There are now three metallurgical engineers in the consulting and research departments and they are, for example, making lay-outs for new foundries or for modernising old ones, for converting drying stoves and the like. They are in regular contact with about three-quarters of the Danish foundries and are co-operating also with the rest.

Stöberiindustriens Forsögs- og Undervisningsstöberi (the research and educational foundry of the Danish foundry industry) works in very close contact with the consulting institution. It has the same staff, but in the foundry there are two moulders and a handy man. It comprises a foundry on the ground floor with about 900 sq. ft. floor space, with a medium size oil-fired drying stove, a small gas-fired core oven and the necessary benches, sand heaps, etc. In the basement there is the sand-preparation plant with an oil-sand mixer, a

(*Concluded on page* 328.)

Stress-Relief Treatment of Iron Castings

Discussion in Manchester discloses controversial points and indicates the need for work on the prevention of residual stresses in castings

A meeting of the Lancashire Branch of the Institute of British Foundrymen was held at the Engineers' Club, Manchester, on February 7, Mr. Harold Haynes, Senior Vice-President of the Branch, in the chair.

A Report entitled "The Stress Relief Treatment of Iron Castings"* was read, and commented upon, by MR. L. E. BENSON (Metropolitan-Vickers Company, Limited) on behalf of the Technical Council of the Institute.

In presenting the Report of the T.S.17 Committee, MR. BENSON prefaced his remarks with a brief note on the nature and development of internal stress in iron castings. The development of stresses on cooling in the mould after casting might be considered very simply by reference to Fig. 1. When a grid-type casting, having the central member thicker than the other two, is cooled down, obviously the central member will cool at a slower rate than the two outer members, cooling curves being, say, as shown in Fig. 2. As cooling proceeds, a temperature difference is set up which evens out again as the casting approaches normal shop temperature.

Above 600 deg. C. it can be said that iron and carbon steel castings are so plastic, and yield so easily, that differential contraction effects cannot result in high internal stress. Thus as the casting cools through the temperature range 600 to 400 deg. C., there is no internal stress, although there may be a large variation in temperature through the casting at any one instant. Below 400 deg. C., however, the metal has acquired very considerable rigidity (*i.e.*, "elasticity" in the engineering sense that stretching or compression results in tensile or compressive stress of proportional magnitude). Because of this the temperature gradients that are present in the casting as it cools below 600 to 400 deg. C. will result in internal stress as they even out to room temperature.

If the difference in temperature between the inner and outer members of the casting seen in Fig. 1 (as it cools below 600 to 400 deg. C.) is 100 deg. C., then the difference in length that has to be accommodated by elastic strain is 100 times the coefficient of expansion, *i.e.*, 100×0.000012 in. = 0.0012 in. per in. of length. As the modulus of elasticity for cast iron is 6,000 tons per sq. in., this means that 0.0012 in. per in. strain will result in a stress difference of $0.0012 \times 6{,}000$ = approx. 7 tons per sq. in. If the stress difference is equally shared between the tension and compression members, then the internal stress in each will be 7 divided by 2 = 3.5 tons per sq. in. In practice, of course, it is more likely that the stress will be unequally shared, so that one member would have a stress less than 3½ tons per sq. in. and the other one a stress greater than this.

*See FOUNDRY TRADE JOURNAL of March 25.

Such figures are quite easily attainable in castings of moderate size and Mr. Benson emphasised the great value to foundrymen of making experiments to demonstrate the sort of temperature differences that were set up in typical castings during cooling.

Mr. Benson also drew attention to the fact that, although loosening castings in the sand may be very desirable to facilitate un-restrained contraction, care should be taken to see that parts of the casting likely to cool most rapidly in the sand were not uncovered. If they were uncovered, the tendency would be to increase the temperature difference set up on cooling.

Attention was also drawn to the difficulty of obtaining even cooling with box-shaped castings having inner walls which were bound to cool down last, even though they might be quite light in section.

The main part of the Report was dealt with in *résumé*, attention being directed particularly to the following important points:—(1) That heating to 550 to 600 deg. C. was essential if substantially complete stress relief was required, and (2) that the soaking period was of lesser importance than obtaining the proper temperature.

The point was also made that, important though the question of stress relief undoubtedly was, the question of the avoidance of internal stress was, perhaps, even more important. The terms of reference of Committee T.S.17 were, of course, "to review present practice in stress relieving iron castings," but a new committee to deal with the prevention of internal stresses was probably even more worth while.

Vote of Thanks

MR. D. FLEMING (Bury), in proposing that a very hearty vote of thanks be accorded to Mr. Benson, said that that gentleman had had a very difficult task to fulfil. His subject-matter was highly specialised, and perhaps was one in which not everybody could display an immediate and enthusiastic interest. Nevertheless, it was extremely important to foundrymen dealing with new types of casting. The Report fully explained the fundamentals of the investigation which had been undertaken. Apparently the earlier work with which Mr. Benson had been associated remained virtually confirmed, and very sincere thanks were due to the Author for having so freely presented his conclusions to the members.

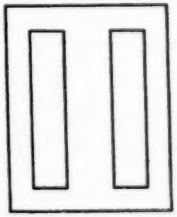


FIG. 1.—GRID-TYPE CASTING.

MR. C. R. VAN DER BEN seconded the vote of thanks, and said a good many snags and

Stress-Relief Treatment of Iron Castings

anomalies were likely to be encountered, and he was impelled to the conclusion that much research work yet remained to be done.

The vote of thanks was carried unanimously with acclamation.

DISCUSSION

The CHAIRMAN (Mr. H. Haynes, Ashton-under-Lyne) emphasised the fact that there were many problems to be solved in connection with the stress-relieving treatment of iron castings. When a casting was down on the floor, and had to stay there 20 days before it could be got out, damage occurred before putting it into the annealing ovens. Foundry science would have to make much progress in dealing with problems of contraction, etc.

MR. H. HULME (Leigh) asked, in the case of a very difficult casting, if the full stress would not be developed until it was completely cold.

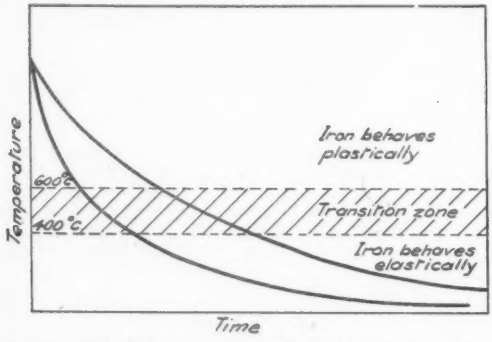


FIG. 2.—COOLING CURVES FOR CENTRAL AND OUTSIDE MEMBERS OF THE GRID-TYPE CASTING.

MR. BENSON said it was apparent that, in dealing with a very difficult casting, the full stress would not be developed until it was completely cold. There had been cases in which castings had cracked days or even weeks after they had been cooled off in the ordinary way.

The average casting was more likely to distort during machining or to distort in service, so that it did not really matter very much whether it was taken out of the sand and put into a warm furnace, which might be the best practice, or was dealt with when cold. In the case of a very big casting, it might be justifiable to take it, when a little warm, out of the sand, and put it straight into an annealing furnace. The point was not raised in the *questionnaire*, so that there had been no specific reply to it.

Possibility of Exothermic Sands for Stress Inhibition

MR. W. DUNKERLEY (Oldham) remarked that much of the American literature dealt with exothermic compounds, and it would be interesting to learn if any of the members had had practical experience of their use, mixed either with the moulding sand or with the core. As Mr. Benson had mentioned, it appeared to be purely a problem of temperature gradients as between one part of a casting and another. Personally, he had thought for some time it might be possible, by using such compounds, either on the cores or the sand faces, so to heat up a part of the mould that the temperature gradient would be more even throughout, in order that the part which would cool more quickly might be kept heated up. He understood there was likely to be quite a dangerous evolution of gas from exothermic compounds, so that trouble might occur through the trapping of gases. It would seem that sufficient time ought to be allowed for the gases to escape, though, in any case, they might be eliminated by means of correct venting.

MR. E. LONGDEN (Manchester) stated that exothermic reaction compounds were employed in the steelfoundry to prolong the freezing period of feed headers on castings. The compounds were used to cover the face of the metal in the feeder head and also to paint the face of the sand in the feeder bush. The reactions with the metal increased the heat content of the metal. But there was, evidently, much danger in using such materials on various parts of a mould or cores having regard to the evolution of gases from the compounds which might blow into the metal.

Where the Designer Fails to Help

He was particularly interested in the after-treatment of castings to relieve stresses, but attention must be paid to what the designer put into the casting to begin with. Foundrymen, generally, were much disturbed by the lack of knowledge of metals on the part of the designer. Many times, strictures were laid by the designer on the foundryman because he did not understand as fully as might be expected, the often very complicated drawings. But he (Mr. Longden) would return the criticism by suggesting that the designer would show himself more acquainted with his job if he understood better the behaviour of cast metals, especially of varying sections, during the cooling down period, so that he could design not only for the required mechanical strengths but, also, for a reduction of stresses during the cooling down of the casting.

A large casting could not be transferred to an annealing oven, before it had cooled down to normal temperatures, without grave danger of its fracturing. Additional strains could thus be introduced into the casting which might develop into a destructive stress. Therefore, strains could be present in large castings which might be aggravated by subsequent annealing if all the conditions were not understood. The largest ovens employed for stress annealing were located in a Midland foundry, but they were limited in capacity.

Certain types of initial strains and incipient cracks could not be removed by subsequent stress-annealing practice. What was the mechanism of stress relief by heat-treatment at the temperatures stated in the report —at 550 C. to 700 deg. C.? Was it due to the further precipitation of graphite, or was it due to the re-orientation of the crystal structure? Probably it was both.

It was acknowledged that there was growth at the annealing temperatures dealt with. The reduction in the carbide and the increase in ferrite would improve the plasticity of the metal which would then respond more readily to contraction or expansion.

He asked what was the cooling rate after the annealing temperature and soaking period? This was more important than the rate of heating up to the required soaking temperature, because a casting could have sections both massive and slender. A simple illustration could be made with the sections of a gear wheel—a heavy boss, a medium-heavy rim and slender spokes. The cooling rate must be slow to allow a uniform fall in the varied sections, otherwise the casting would break.

MR. BENSON thought that the relationship between the engineer and the foundryman was a point well worth making. A foundryman might well complain of some of the engineer's designs because they were extremely difficult to understand. He would suggest that it was incumbent upon the foundryman to make his difficulties known to the engineer who usually had very little foundry experience. It was very often the case that alternatives could be adopted, and a very simple example was that of the grid which had been shown in Fig. 1. "It could be very easily arranged with an internal partition and could be cast with a gap in it, so that it might be free to expand and there would be no straining. The gap could be closed afterwards by bolting a piece on.

He had had experience of buying large steel castings from other foundries, and never had any hesitation in telling their managements that if there was any difficulty in casting he should be informed of the fact so that the casting might be somewhat modified. Foundrymen seemed to be afraid that if they mentioned anything themselves they woud be considered as not knowing their job. The average engineer would not view the matter in that light; he would certainly go out of his way to alter a design if it would be of any assistance to do so.

The Mechanism of Stress Relief

An important question was what was the mechanism of stress relief. The answer was not simple. Probably no one knew what was the fundamental reason, but the fact was that whether a piece of steel, a piece of cast iron, a piece of copper, or any other metal, was stressed suddenly it tended to behave elastically or stretch, and when the stress was taken away the metal tended to return to where it was before, within certain limits. If the stress prevailed for a long time, particularly at elevated temperatures, the metal would tend to behave more like a piece of pitch. It would tend to pull out very slowly, and in his, Mr. Benson's, opinion this was to be described as "creep." Why any metal should behave in these two ways no one knew. The fact was that sometimes the rows of atoms which made up the crystals expanded like a bellows and then returned to their former position. Sometimes they slipped and did not go back, and they tended to slip under a stress which was applied for a very long time at a somewhat elevated temperature.

What was done in stress relieving was to increase the temperature to a point where the slipping or permanent yielding occurred in a measurable period of time, say, an hour or six hours. When this happened the stressed members yielded a little and became slightly longer in some cases, while others in tension yielded a little and became permanently crushed, any elastic strain in them being dissipated in the process. If they were cooled down slowly they became stable. This was the best answer he could give to a very difficult question.

The cooling rate from the annealing temperature was very important. If the casting were taken out of the oven and quenched, say, in a canal alongside, there would be trouble because a new system of internal stress would be developed. The cooling must be done very slowly. In actual practice, short steps should be taken. There would be risk involved by cooling quickly, especially from above 250 deg. C.

Mr. Longden thought that according to the figures presented there was only a small fall in the Brinell hardness values after stress relieving at the recommended temperatures. The tensile figures did not indicate a serious fall in strength. It could be suggested that the fall in tensile and hardness values was due to the increase in graphite. Cast iron thoroughly annealed at very high temperatures could be bent and twisted in the cold state.

MR. BENSON was sorry he had not made the point clear. At 600 deg. C., where the stress relief effect was most marked, there was a little graphitisation, but sufficient to affect slightly the physical properties. There was also a little spheroidation of the pearlite. The fine lamellæ of the pearlite would tend to form a series of globules under surface tension. This, again, would tend to alter the physical properties and soften the iron a little. So that at a stress-relieving temperature of 600 deg. C. there would be a small change in the physical properties. The tensile strength would be reduced, but this would not appear to be related to the stress-relieving effect. It occurred at the same time, but the stress-relieving effect did not depend upon it. There would be the same relief of internal stresses if that change did not occur.

MR. E. LONGDEN differed from that point of view. If a certain member of a casting. due to its section, contracted more than a heavier section, then a growth in the metal would relieve it by expanding it and taking up a longer length.

MR. BENSON thought this would not be right. It was correct that there would be little growth, but there would be growth in both the thick and the thin members, and those growths would cancel one another out. When dealing with a piece of copper or a piece of pure iron it did not suffer growth in the same way. It did not suffer any structural change, but there could still be the stress-relieving effect, although there was no graphite and no carbide. Therefore the structural change was not necessary for stress relief.

Mr. E. Longden agreed that there would be growth. If the casting had thick and thin sections there would be a growth in all directions and not just externally. The thinner sections were also subject to growth and,

Stress-Relief Treatment of Iron Castings

therefore, the extension of these sections would nullify the stress to a large extent.

MR. BENSON thought it would be better to compromise on the matter. It would be better to agree there would be growth, and that the growth might affect the amount of stress which was present, but the stress would still occur.

MR. G. A. SOUTHERN said it was not aways a consideration of growth which mattered. What about contraction, also? In regard to stress relief, surely some parts of the casting might not grow. It might be simply a question of relief of stress where the atoms contracted in themselves and slipped back. This might also help some stress relief.

MR. W. DUNKERLEY (Oldham) was of opinion that stress relieving could take place at much lower temperatures than those at which growth took place. Growth would not have any effect whatever, and he was inclined to agree with Mr. Benson and Mr. Southern. He certainly agreed that stress relief sometimes did result in a contraction of a member and not its expansion. Growth would not be of any assistance whatever.

MR. BENSON said it was quite correct that in the stress-relieving treatment some of the members would shorten and some would lengthen.

(To be concluded.)

B.C.I.R.A Elects New Members

The following firms have been elected members of the British Cast Iron Research Association. The official representative in each case is shown between brackets. Richard Ashton & Company, Limited, Birmingham (Mr. J. C. M. Heath); James Bates & Sons, Winsford, Cheshire (Mr. A. B. Bates); Crescent Iron & Steel Corporation, Limited, Bombay (Mr. H. J. Rehmani); John Heathcoat & Company, Tiverton, Devon (Mr. E. W. Nott); Kirloskar Brothers, Limited, Kirloskarwadi, India (Mr. S. L. Kirloskar); Lambert Brothers (Walsall), Limited, Walsall (Mr. C. S. L. Incledon); Lloyds (Burton), Limited, Burton-upon-Trent (Mr. W. R. Cooper); Longford Engineering Company, Limited, Bognor Regis (Mr. C. R. Purley); and Service (Engineers), Limited, Stoke-on-Trent (Mr. J. A. Johnson).

Enrichment of Cupola Blast

According to the "Iron Age," an American foundry experimenting with the 5 per cent. oxygen enrichment of a cupola blast has found the practice badly eroded the lining. In 2 hr. of steadily blowing the enriched blast, 10 in. of lining thickness was burned out in the melting zone of the cupola. Ordinarily, this foundry runs its cupolas at least 16 hr. before any patching is needed in the refractory lining.

MEMBERSHIP OF THE American Foundrymen's Association is now 10,280.

The Danish Foundry Industry

(*Continued from page* 324.)

mill and an aerator of the German "Samum" type. In the yard there are a 20-in. cupola and two coke-fired crucible furnaces, the one a tilter, the other a lift-out furnace. In order to have the foundry working continuously (*i.e.*, 8 hrs. a day) and to supplement the requirements of research work, the laboratory made an arrangement with Burmeister & Wain, by which they send their patterns and buy the castings made from them. When there is sufficient research work, the foundry does not make anything for outside interests. Generally, the cupola runs once per week. This arrangement is quite new—the foundry was started in 1943—but the regular work only began in October, 1947.

Den danske Stöbemesterskole (the Danish foundrymasters' school) was established in 1943. It operates a four-year evening class. The students are nearly all moulders, and it is necessary before entering the school for them to have finished the apprenticeship, an approved course, and to have worked at least two years as a moulder. The idea of the evening school is that the students may work in the daytime as moulders (some of them as foremen), so as to earn their living. The school-year starts at the beginning of September, and there are four evenings per week, with three hours each, for 33 weeks. The first year is a preparatory class, where the students are taught arithmetic, algebra, physics, chemistry, English, German and Danish. In the following three years they learn foundry technology: melting furnaces, moulding, gating and risers, alloying, calculations, sand preparation, and the like. . . . If readers are interested, the Author offers to have the complete curriculum translated into English.

There are generally 20 to 25 students in each class, and a new class is only started every four years, when the previous class has finished. The school course finishes with an examination, following which the successful students get a "diploma." In the Spring of 1947 the first 17 students finished the course, and the school is now busy with 26 "freshmen." The students who left in the Spring, 1947, have all obtained positions as foremen or "masters" in various foundries.

The Author is director of all these three institutions. The teachers of the foundry school are executives, foremen, "masters," and other employees in the industry, who give up their evenings to teaching. However, as there are available a fair number of teachers, none of them has too many evenings taken up. It is thought that this will give readers an idea of the Danish organisation, but if any are interested in further details, the Author will gladly make amplification.

A CONFERENCE ON "Management in Industry" is being held under the auspices of the Conservative Political Centre on April 10 and 11 in the North Hall, Church House, Westminster, London, S.W.1. Further particulars are available from the organising secretary, 59, Victoria Street, London, S.W.1.

Tributes to Nobel Prizewinners

Science in Industry

Tributes to Sir Robert Robinson and Sir Edward Appleton, winners respectively of the 1947 Nobel prizes for chemistry and physics, were paid at a complimentary dinner given by the Federation of British Industries in London. The Prime Minister said those great scientists had made outstanding contributions both in fundamental research and in the application of science to the needs of the community. We had to improve the quality and the quantity of our products, and he believed that industry to-day was far more alive than it had ever been to the value of fundamental research. He believed that industrialists appreciated that one could not expect quick returns, but that fundamental research would lead to greater returns than something which for the moment might look more attractive. There was a greater readiness to apply in the sphere of practical production the results of laboratory experiments.

Mr. Attlee said he thought that a great deal was due to the work of the Department of Scientific and Industrial Research in the promotion of research organisations of all kinds. He hoped the National Development Corporation would fill any gaps there might be in the development of academic discovery to full-scale production.

Replying to the toast which the Prime Minister had proposed, Sir Edward Appleton said our recent preoccupation with science in the defence of our country and in the support of our industries might perhaps suggest that our concern had been exclusively with the material consequences of science. But we must never forget that science enlarged men's minds and could bring home to every one the wonder and significance of the world in which we lived. To that end our science teaching in our schools and universities should be far more than mere vocational training. Atomic energy in itself threatened no one. It was the possible use of atomic energy by nations prompted by hatred, envy, and fear that had brought a new apprehension into our lives. Yet that apprehension was merged with a benevolent promise for mankind, for it happened that although the atoms of Uranium 235 could be used in an atomic bomb, they could also be used in an atomic power station to provide light and warmth.

Sir Robert Robinson also replied to the toast.

Significant Occasion

Earlier in the day members of the Industrial Research Committee of the F.B.I. met in the lecture theatre of the Royal Institution to pay tribute to the work of the two scientists. Sir Frederick Bain, president of the Federation, said that the occasion had a special significance, for not since 1904, when Sir William Ramsay and Lord Rayleigh were awarded them, had the prizes for chemistry and physics come to Britain undivided and undisputed.

Sir Robert Robinson said that progress in extending facilities for research in organic chemistry was not fast enough. Britain, in this connection, was spending too much of its little pocket-money on cake and not enough on bread and butter. He suggested four steps—higher pay for science teachers, the enlarging and modernising of university departments, the parallel growth of industrial research laboratories, and the expansion of technical colleges.

Sir Edward Appleton described the pattern of scientific research in Britain as a triangle, with university science at one corner, industrial science at another, and Government science at the third. There should be no segregation, for each corner was dependent for stimulus and assistance on the other two. In both Government and industrial laboratories, the more liberally the restrictions imposed on the scientific worker in the pursuit of specified objectives were interpreted, the better would be the scientific health of those who worked in them. Britain's success in the war had depended largely upon the mutual understanding which grew up among the General Staff, the scientists, and the production men. In peace, we needed the same sense of partnership among management, science, and other branches of industry, including labour.

Sir Wallace Akers, director of research, Imperial Chemical Industries, Limited; Sir William Larke, chairman of the F.B.I. Industrial Research Committee; and Sir H. T. Tizard, chairman of the Scientific Advisory and Industrial Productivity Committees, also spoke.

Royal Society Elects New Fellows

Among those who have been elected into the Fellowship of the Royal Society are the following:—

MR. T. E. ALLIBONE, director of the research laboratories of Associated Electrical Industries, Limited, distinguished for contributions to the application of high-voltage phenomena; MR. F. P. BOWDEN, lecturer in physical chemistry, Cambridge University, distinguished for contributions to the study of friction and lubrication; MR. H. CONSTANT, Deputy Director (Research), National Gas Turbine Establishment, distinguished for studies in applications of thermodynamics and aerodynamics to aircraft engines; MR. S. F. DOREY, chief surveyor, Lloyd's Register of Shipping, distinguished for contributions to marine engineering; MR. O. R. FRISCH, Jacksonian Professor of Natural Philosophy, Cambridge University, distinguished for researches on fission processes in nuclear physics; MR. W. H. HEITLER, Senior Professor in the School of Theoretical Physics, Institute of Advanced Studies, Dublin, distinguished for contributions to theoretical physics; MR. S. PEAT, Reader in Organic Chemistry, Birmingham University, distinguished for contributions to constitution and synthesis of carbohydrates; MR. J. W. RYDE, senior physicist of the research laboratories of the General Electric Company, Limited, Wembley, distinguished for contributions to pure and applied physics; MR. E. W. R. STEACIE, director, Division of Chemistry, National Research Council, Canada, distinguished for researches on gaseous chemical reactions.

Personal

PROF. L. F. R. WILLIAMS has been appointed a director of Darwins, Limited, high-speed steel manufacturers, of Sheffield.

MR. CHARLES A. E. PYNE, of Lewis, Webb & Company, iron, steel, and mineral merchants, etc., of Stourbridge, has retired after 63 years' service with the company.

MR. HUGH WEEKS, Assistant to the Chief Planning Officer, Sir Edwin Plowden, has been appointed Controller of Plans to the Government's £100,000,000 Colonial Development Corporation.

MR. FOLLIOTT SANDFORD NEALE, who has been appointed Sheriff of Shropshire, is a civil engineer. He was at one time manager of the steelworks of W. Martin Winn, Limited, Darlaston, Staffs.

MR. HENRY HUME SAUNDERS has retired from the position of joint managing director of Vulcan Foundry, Limited, Newton-le-Willows, Lancs, for health reasons. He will be succeeded by MR. GERALD COLLINGWOOD, general manager.

MR. W. GLEED has been appointed North London and Home Counties representative for the sale of the compressed-air products of the Atlas Diesel Company, Limited, in place of MR. W. L. FAIRLESS, who is joining the company's South African associates.

MR. JOHN BELL has been appointed deputy chairman and has resigned from his position as managing director of the Projectile & Engineering Company, Limited, Battersea, London, S.W.8. MR. A. J. CHAMBERS has been appointed general manager of the company.

MR. F. G. BACON, MR. H. C. BLENCH and MR. J. M. GRAHAM have been elected to the board of International Alloys, Limited, Slough, Bucks. Mr. Bacon and Mr. Blench are, respectively, production director and sales director, while Mr. Graham is a director of Almin, Limited.

MR. W. P. HECKELS, naval architect of John Readhead & Sons, Limited, South Shields, has been appointed shipyard manager. He has been with the company for 31 years. MR. J. MARTIN, who has been with the company since 1899, has been appointed outside manager (shipyard department).

MR. ARTHUR ATKINSON, patternshop manager at Ashmore, Benson, Pease & Company, Limited, Stockton-on-Tees, has just completed 65 years' service with the company. He has been presented with an antique silver salver in recognition of his long service. Mr. Atkinson, who is 87 years of age, is still in harness.

MR. D. G. SOPWITH has been appointed superintendent of the engineering division of the National Physical Laboratory of the Department of Scientific and Industrial Research to fill the vacancy caused by the appointment of DR. G. R. HANKINS, as director of mechanical engineering research in the Department. Mr. Sopwith, who is 41 years of age, has been at the N.P.L. for 20 years and recently has been senior principal scientific officer in the engineering division. He is a Whitworth Scholar.

DR. ULICK R. EVANS and DR. JOHN M. PEARSON, two eminent research authorities, are to receive the 1948 awards of the [American] National Association of Corrosion Engineers. Dr. Evans has been associated with Cambridge University since 1919. He has been engaged continuously in scientific work, mainly in studies of corrosion of metals, thin films on metals and recrystallisation changes in metallic structures. He has published some 180 Papers, and in addition to lecturing at Cambridge, he has delivered many lectures throughout the world. Dr. Pearson is the director of the physical division of the research and development department of the Sun Oil Company, Dallas, Texas.

MR. HAROLD A. AKROYD retired from his appointment as managing director of the Yorkshire Engine Company, Limited, Sheffield, yesterday (Wednesday). He is remaining on the board as consultant. He joined the staff of the company in 1906 as leading draughtsman, and was appointed chief draughtsman the following year. He became assistant general manager in 1928, general manager in 1936 and a director in 1938. On Mr. Akroyd's retirement, MR. R. A. DYSON becomes managing director, and MR. K. C. BANKS general manager. MR. J. N. COMPTON, who was chief mechanical engineer of the Great Indian Peninsula Railway and who has recently held the post of chief controller of standardisation of the Indian Railway Board, has joined the company as mechanical engineer. He will be in charge of all matters of design and production.

Wills

MITCHELL, W. L., formerly secretary of Jonas Wells, Limited, iron and steel founders, of Keighley ... £16,165

RICHARDS, P. R., a director of Charles Richards & Sons, Limited, nut and bolt manufacturers, etc., of Darlaston £286,308

BERRESFORD, H. H., managing director of the Staveley Coal & Iron Company, Limited, Chesterfield, and a director of other companies £91,812

SIR WILLIAM TALBOT, chairman of the Talbot-Stead Tube Company, Limited, Walsall, and of the Chesterfield Tube Company, Limited £132,712

HOOKER, W. J., managing director of W. J. Hooker Limited, agents for foundry plant and supplies, etc., of Finchley Road, London, N.W.3. ... ... £5,744

TALBOT, BENJAMIN, chairman and managing director of the South Durham Steel & Iron Company, Limited, and the Cargo Fleet Iron Company, Limited, Middlesbrough £201,784

Gazette

BRYMBO STEEL COMPANY, LIMITED, is being wound up voluntarily. Mr. F. B. Proctor, 65, Fenchurch Street, London, E.C.3, is the liquidator.

PERFECT DAIRY MACHINES (ENGLAND), LIMITED, is being wound up voluntarily. Mr. A. Mair, 34, Palace Court, London, W.2, is the liquidator.

CWMBRAN ENGINEERING COMPANY, LIMITED, is being wound up voluntarily. Mr. E. C. Baillie, 23, Blomfield Street, London, E.C.2, is the liquidator.

Allocations of Tin Metal

Final Distribution for First Half of Year

Further allocations of tin metal for the first half of 1948, totalling 13,940 long tons, have been made by the Combined Tin Committee. The quantity of tin metal now allocated to meet requirements for the first half of the year totals 33,246 long tons. The new allocations, together with the allocations announced previously, are expected to represent final allocations for the first half of the year for most of the countries. It may, however, be possible for the committee to make small additional allocations after a further review of the supply position in May.

Certain countries have not yet submitted adequate statistical data to enable the committee to recommend further allocations at this time. On receipt of proper data, further allocations to such countries will be made, sufficient reserves of tin having been set aside to meet expected requirements.

Supplies may be obtained from the following sources:—The United Kingdom, on behalf of Malaya; Hong Kong; the Netherlands; Belgium; China; Siam; and the United States for stocks of Japanese tin. In addition, small demands of certain Latin American and Middle East countries may be met from British, Belgian, Dutch and United States sources, within the block tonnage allocated to " other Latin American and Middle East countries."

Shipyard Workers' Wages Claims

The unions' wages claims will be presented at conferences between the Confederation of Shipbuilding and Engineering Unions and the Engineering and Allied Employers' National Federation and the Shipbuilding Employers' Federation on April 14 and April 21 respectively. The Confederation is claiming a national minimum consolidated skilled rate of £5 15s. per week and a national minimum consolidated unskilled rate of £5 per week, with *pro rata* adjustments in the wages of intermediate grades, and the maintenance of existing differentials. The claim also includes that piecework prices, bonus or basis times be such as will enable a workman of average ability to earn not less than 20 per cent. of the new consolidated rates, and that workpeople employed on piecework systems to which the base rate bears no relationship shall receive the same increase as timeworkers.

Shipbuilding employers will be asked to consider the introduction of a national minimum consolidated skilled rate of £5 19s. per week and a national minimum consolidated unskilled rate of £5 per week, with equivalent differences in the wages of intermediate grades and pieceworkers.

H.M.S. RECLAIM, a submarine rescue vessel which will carry new apparatus for submarine rescue and salvage, has been launched from the yard of Wm. Simons & Company, Limited, at Renfrew.

Limestone Supplies Endangered by Labour Shortage

Possible Effect on Steel Production

Supplies of limestone to the iron and steel industry and other vital industries are being jeopardised by shortage of labour, which is acute. Leaders of the industry have repeatedly warned the Government of the danger of dropping man-power. The position is being aggravated because German prisoners-of-war—a substantial percentage of the force available in many cases—are being sent home without any attempt being made to find replacements. Recruitment of British personnel is proving difficult because of prejudice. Young men returning from the Forces are refusing well-paid jobs in quarries because the work, they say, is too arduous.

Speedy mechanisation would alleviate the situation, but without the grant of priority, little can be done in this respect. It is, indeed, a vicious circle, for while mechanisation is being delayed at the quarries for lack of steel, steel production is likely to be affected by inadequate supplies of lime. In addition to its importance to the steel industry, lime is an essential item in the manufacture of a great many of the things used in everyday life.

In the past 10 years there has been a drop of 6,000 people employed in limestone quarrying. P.O.W. labour forms 10 per cent. of the 11,000 now employed and at some quarries the percentage is as high as 60.

United Kingdom Tin Position

The Ministry of Supply has released the following figures showing the United Kingdom tin position for the month of January:—

		Ministry.	Consumers.
		Long tons.	Long tons.
TIN METAL:			
Stocks at January 1		6,188	2,778
Arrivals		—	—
Production		2,728	—
		8,916	2,778
Deliveries:			
To U.K. consumers	2,690	—	2,690
For export	143	2,833	—
		—	5,468
Consumption		—	2,460
Stocks at January 31		6,083	3,008*
TIN ORE (tin content):			
Stocks in U.K. at January 1		6,357	—
Stocks in U.K. at January 31		5,612	—

* Calculated. Reported 3,203 tons.

A NOTABLE LANDMARK in North Staffordshire, the three chimneys which for many years have marked the site of the former Knutton Ironworks, are in the process of being demolished, as they are considered to be unsafe.

News in Brief

MR. HUGH DALTON, P.C., M.P., will open Design Week—Wales on April 12.

THE ELECTRIC LAMP MANUFACTURERS' ASSOCIATION has announced reductions in the prices of electric lamps.

F. PEEL & SONS has been granted permission to use a former cinema at Carlin How, Yorks, as a temporary foundry.

THE NORTH BRITISH LOCOMOTIVE COMPANY, LIMITED, Glasgow, has received an order for 42 locomotives for the Nigerian railways.

EXHIBITORS IN THE engineering and hardware section of the British Industries Fair at Castle Bromwich this year number 1,121, or 74 more than in 1947.

THE BRUSH ELECTRICAL ENGINEERING COMPANY, LIMITED, has received two orders for turbo-alternator sets for Northern Rhodesia and South Africa.

JOHN READHEAD & SONS, LIMITED, South Shields, has received an order from the Strick Line, Limited, London, for a passenger/cargo liner of 11,000 tons d.w.

BERRY HILL (ENGINEERS), LIMITED, has taken over the Berry Hill Plant Division of Berry Hill Collieries, Limited. There will be no change in the management.

JOSEPH L. THOMPSON & SONS, LIMITED, Sunderland, is to construct a new fitting-out quay. A 33-year lease of the land has been granted by the Wear Commissioners.

THE NATIONAL ACTING COMMITTEE of the Engineering and Allied Trades Shop Stewards' National Council has passed a resolution pledging full support for the wage claim tabled by the engineering unions.

A SOUTHAMPTON FIRM of boat and yacht builders proposes to establish a shipyard at Campbeltown, Argyll. Plans have been passed by the Town Council and will be sent to Argyll County Council for approval.

SEVENTY WELDERS employed by Palmers (Hebburn), Limited, who had been on strike since February 24, returned to work last week on the same terms as those on which they went on unofficial strike.

LONG-SERVICE AWARDS were presented recently to 77 employees of the three Bilston works of Joseph Sankey & Sons, Limited, whose aggregate services total 2,100 years. The recipients included 11 women.

JAMES LAMONT & COMPANY, LIMITED, Greenock, has received an order from British owners to build a cargo motorship of 1,350 tons d.w. The propelling machinery will be supplied by British Polar Engines, Limited.

A LIVERPOOL METALLURGICAL SOCIETY was formed at a recent meeting of the Liverpool University Metallurgical Society, when Dr. S. J. Kennett was in the chair. A committee was elected to organise the first session.

THE CHAIN MAKERS' AND STRIKERS' ASSOCIATION has decided to apply to the employers' association for an increase in the holidays-with-pay grant from £4 10s. to £6 and for an advance in the amount of statutory holiday with pay from 15s. to £1.

CHARLES CLIFFORD & SON, LIMITED, copper and brass-tube makers, etc., of Birmingham, announces that unavoidable delay has been experienced in completing the audited statement of accounts for 1947 and, consequently, it is necessary to defer the date of the annual meeting.

THE VISCO ENGINEERING COMPANY, LIMITED, Croydon, has received a contract for a panel-type viscous air-filtration plant with a capacity of 3,600,000 cub. ft. per min. It is believed that the plant will be the largest air filter in the country and possibly the largest in the world.

THE EXTENSION of the open-hearth system at the Corby Steelworks of Stewarts and Lloyds, Limited, is expected to be in operation about the middle of next year. Work will be found for a further 200 or 300 men and there will be an additional production of between 120,000 and 140,000 tons of steel a year.

THE SCRAP METAL ASSOCIATION of North Rhine-Westphalia has announced that the export of scrap steel from the British zone of Germany to Britain started on March 16. After negotiations, on the initiative of the British Military Government, about 20,000 tons of scrap a month will be sent to Britain at a price of £6 10s. a ton.

HARBOROUGH CONSTRUCTION COMPANY, LIMITED, Market Harborough, has appointed Mr. Denis Waters, 17, Grove Terrace, Teddington, Middx, as its representative for the sale of the company's products in the southern counties. Mr. Waters continues his representation of James Hargreaves & Sons, Leeds, Limited, for the sale of foundry coke in the same area.

THE SOUTH DURHAM STEEL & IRON COMPANY, LIMITED, has despatched to Sheffield a blank holder slide over 13 ft. wide, 13 ft. 7 in. long and 9 ft. 10 in. deep, for machining and finishing. The equipment is part of a large flanging press for the Loewy Engineering Company, Limited, Bournemouth, and is one of the biggest welded fabrication units made by the company.

SIR J. H. M. GREENLY, chairman of Babcock & Wilcox, Limited, who has been in the service of the company for 19 years, was guest of honour at the company's graduates' and students' dinner on March 18, when he said he was looking forward to completing 25 years with the firm. Students were present from South Africa, Australia, India, South America, and China.

AFTER ALMOST a week's stoppage, 200 boilermakers employed at the North Road and Stooperdale Railway Works, Darlington, decided to return to work while negotiations were opened for a discussion of their wages claim. The stoppage was the result of another strike at the works involving cranemen, which held up the work of the boilermakers and, consequently, lowered their wages.

PRESIDING AT THE recent annual dinner of the Institute of Marine Engineers, Sir Amos Ayre said that the industry had an economic plan to produce 1,750,000 tons per annum, but it was getting enough steel and other material to produce only 1,000,000 tons. The difference between those figures was the degree of frustration which British shipbuilders and marine engineers were undergoing.

MEMBER-FIRMS OF THE British Electrical and Allied Manufacturers' Association have been asked to do all they can to implement the F.B.I. recommendations regarding prices and profits. The association emphasises that reduced prices will depend on how far costs, stabilised in other respects, can be lowered by increased productivity resulting in a greater quantity of goods being produced each week by the same number of people.

A TWO-SESSION CONFERENCE on "The Human Factor in Industry," arranged by the British Association, will be held at Leamington Spa on May 8. Sir Henry Tizard, F.R.S., president of the association and chairman of the Cabinet's Advisory Council on Scientific Policy, will preside at the first session, and Sir George Schuster, chairman of the Industrial Productivity Committee's Panel on Human Factors will occupy the chair at the second.

HEAD, WRIGHTSON & COMPANY, LIMITED, engineers and founders, of Thornaby-on-Tees, is offering to ordinary and preference share holders for subscription 300,000 4½ per cent. cumulative preference £1 shares at 21s. 6d. per share, ranking with the existing 169,130 6 per cent. cumulative preference shares. The £150,000 4½ per cent. debentures outstanding will be repaid out of the proceeds, and the balance will be used for the purchase of plant and machinery, etc.

A GIANT VACUUM CLEANER with an intake of up to 1½ tons of dust an hour will be on show at the Birmingham section of the British Industries Fair. Designed for industrial uses, it is particularly adapted for handling hot-flue and retort dusts and has watercooling and cyclone separating units. Powered by either a 6-h.p. or a 10-h.p. motor, it is most suitable for gasworks' retort houses and the flue cleaning of Lancashire and similar boilers. Other types of industrial vacuum cleaners will be exhibited.

FIGURES ISSUED by the South Wales Cargo Clearing House show that exports of miscellaneous manufactured goods from the general industries in South Wales and Monmouthshire, in January, totalled 4,615 freight tons, of which 52 per cent. was shipped through the South Wales ports. This is the highest percentage yet recorded. The percentage of iron and steel originating in South Wales and Monmouthshire and shipped through the ports was maintained at 83 per cent., while the percentage of tinplates shipped locally was 94.6 per cent. Exports of copper and other metals were again low at 1,895 tons.

SPEAKING AT A LUNCHEON at Newcastle-upon-Tyne recently, attended by representatives of the North-East steel industry to launch a drive for 25,000 tons of scrap weekly, Mr. E. Boot, general manager of the Consett Iron Company, Limited, and chairman of a joint committee representing the N.-E. steel industry and the scrap merchants, said that there were still unexploited sources of scrap in rural areas and also among housewives. He added that the public should not be put off by seeing large dumps of scrap up and down the country, as this was largely alloy steel which, for technical reasons, could only be used in small quantities.

Industries' Response to Price Cuts

Manufacturers' Prompt Action

Within a week 30 industries and many individual firms have reported on their detailed examination of prices in accordance with the recommendations set out in the report on prices and profits submitted to the Chancellor of the Exchequer by the F.B.I., the Association of British Chambers of Commerce and the National Union of Manufacturers. Making this announcement last week, the Federation of British Industries stated that reductions in prices have already been decided on in many categories of consumer goods. Cuts have also been decided on in many categories of industrial goods, including certain classes of engineering components and accessories, white lead, lead oxides, pig-iron products, and engineering tools.

Prices will be held at their present level, in spite of increased costs, by many manufacturers whose products or processes include certain classes of metallic bedsteads, leather belting, oil seal, ball and roller bearings, steel and brass founding, electrical and general engineering components, industrial plant, iron castings, and chain drives.

Among the many companies which have announced their intention of observing the dividends limitation suggested by the F.B.I. and other organisations, are:—Stewarts and Lloyds, Limited; Hopkinsons, Limited; C. A. Parsons & Company, Limited; British United Shoe Machinery Company, Limited; Clarke, Chapman & Company, Limited, and Ward & Goldstone, Limited.

Contracts Open

The dates given are the latest on which tenders will be accepted. The address is that from which forms of tender may be obtained.

Axminster, April 13—Construction and maintenance of approx. 930 yds. Class C asbestos cement pipes, 220 yds. of Class E spun-iron pipes, and 430 yds. Class D spun-iron pipes, etc., for the Rural District Council. Silcock & Simpson, consulting engineers, 10, Park Row, Leeds. (Fee £2, returnable.)

Haverfordwest, April 8—Construction of approx. 6,400 yds. of concrete pipe sewers with approx. 1,060 yds. of 12-in. and 9-in. dia. iron pipe sewers, etc., for the Rural District Council. Mr. D. Watkin Rees, engineer, National Provincial Bank Chambers, Ammanford. (Fee £5 5s., returnable.)

Tredegar, April 10—Supply of (1) 8-in. cast-iron mains and connections; (2) 12-in. cast-iron mains and connections; (3) a boosting plant, for the Urban District Council. Mr. S. L. Filer, engineer and manager, Gas Department, Poplar Road, Tredegar.

Warrington, April 26—Construction of approx. 8,000 yds. of concrete, 1,530 yds. of 21-in. and 18-in. spun-iron, and 370 yds. of stoneware pipe sewers, etc., for the Corporation. John Taylor & Sons, engineers, Artillery House, Westminster, London, S.W.1. (Fee £5, returnable.)

Imports and Exports of Iron and Steel

The following tables, based on Board of Trade returns, give figures of imports and exports of iron and steel in February and the first two months of 1948. Figures for the corresponding period of 1938 are given for purposes of comparison.

Total Exports of Iron and Steel.

Destination.	February, 1948.	Two months ended February.	One-sixth of 1938.
	Tons.	Tons.	Tons.
Eire	4,885	11,011	9,286
Channel Islands	574	1,516	1,326
Gibraltar	428	862	147
Malta and Gozo	294	714	384
Cyprus	248	723	276
Palestine	2,149	5,529	1,346
British West Africa	3,640	8,612	8,290
Union of South Africa	12,263	25,845	38,512
Northern Rhodesia	65	243	3,428
Southern Rhodesia	784	1,117	6,036
British East Africa	3,236	10,911	4,322
Bahrein, Koweit, Qatar and Trucial Oman	1,336	3,283	—*
India, Pakistan, etc.	4,103	10,800	26,444
British Malaya	1,399	2,946	11,098
Ceylon	667	1,867	4,338
North Borneo	674	1,646	19
Hong Kong	1,336	2,656	3,932
Australia	3,671	9,314	28,482
New Zealand	4,956	11,472	21,980
Canada	434	1,350	14,234
British West Indies	960	3,177	7,374
British Guiana	10	195	499
Anglo-Egyptian Sudan	445	1,708	1,382
Other British countries	708	1,914	2,327
Russia	294	294	724
Finland	8,948	12,920	2,934
Sweden	9,358	16,845	1,996
Norway	3,188	8,195	3,378
Iceland	277	642	110
Denmark	4,565	13,050	14,542
Poland	37	67	414
Netherlands	6,739	14,232	8,594
Belgium	1,519	2,576	3,388
France	512	2,664	2,232
Switzerland	1,734	3,305	464
Portugal	2,847	5,345	1,286
Spain	342	853	1,294
Italy	265	515	856
Hungary	—	34	5
Czechoslovakia	70	99	386
Greece	316	733	292
Turkey	1,112	2,339	2,292
Dutch East Indies	1,270	4,657	4,552
Dutch West India Islands	496	1,271	410
Belgian Congo	31	137	51
Algeria	35	50	9
Portuguese East Africa	459	534	2,370
Syria	39	129	434
Lebanon	292	813	
Egypt	4,592	9,090	5,734
Iraq	1,594	5,489	4,290
Iran	6,723	14,803	18,394
Burma	2,628	6,910	3,086
Siam (Thailand)	149	429	999
China	3,140	6,613	3,751
U.S.A.	125	394	364
Cuba	19	423	120
Colombia	973	1,523	637
Venezuela	4,729	10,280	780
Ecuador	—	225	266
Peru	6	750	505
Chile	17	1,471	1,048
Brazil	2,122	3,379	2,832
Uruguay	785	1,867	1,264
Argentine	3,459	11,336	13,226
Other foreign countries	3,038	5,951	13,631
Total	128,109	292,643	319,312

* Included in "Other British countries" and "Other foreign countries."

Total Imports of Iron and Steel.

From	February, 1948.	Two months ended February.	One-sixth of 1938.
	Tons.	Tons.	Tons.
Australia	1,771	8,266	6
Canada	4,079	8,782	19,562
Other British countries	145	194	26,868
Sweden	1,217	2,420	14,966
Norway	2,309	4,322	5,628
Germany	17	252	16,000
Belgium	4,815	8,916	45,612
Luxemburg	651	796	9,766
U.S.A.	11,063	24,130	33,448
Other foreign countries	662	2,610	52,180
Total	26,729	60,688	224,046
Iron ore and concentrates—			
Manganiferous	—	—	10,380
Other sorts	587,048	1,260,880	850,312
Iron and steel, scrap and waste, fit only for the recovery of metal	46,085	94,041	105,308

Exports of Iron and Steel by Products.

Product.	February, 1947.	Two months ended February.	One-sixth of 1938.
	Tons.	Tons.	Tons.
Pig-iron	29	33	15,656
Ferro-alloys, etc.—			
Ferro-tungsten	132	238	86
Spiegeleisen & ferro-manganese	1,208	2,197	866
All other descriptions*	55	120	174
Ingots, blooms, billets and slabs	125	631	1,624
Iron bars and rods	318	657	532
Sheet and tinplate bars, wire rods	198	852	2,594
Bright-steel bars	2,420	4,526	1,098
Other steel bars and rods	8,841	20,178	17,000
Special steel	1,681	3,574	822
Angles, shapes and sections	7,901	14,452	11,146
Castings and forgings	521	1,068	270
Girders, beams, joists and pillars	1,554	3,438	5,578
Hoop and strip	2,896	6,185	6,230
Plates ¼ in. thick and over	8,718	17,587	21,826
Black plates	4,908	10,520	2,422
Black sheets	1,373	4,361	10,584
Galvanised sheets	4,668	9,853	24,488
Tinplates	12,021	28,941	53,216
Tinned sheets	369	880	234
Terneplates	29	33	720
Decorated tinplates	97	173	728
Other coated plates	276	541	38
Cast-iron pipes, up to 6-in. dia.	3,486	10,466	8,154
Do., over 6-in. dia.	2,411	6,447	7,160
Wrought-iron tubes	22,037	45,753	36,664
Radiators and central-heating boilers	323	656	671
Railway material	8,461	21,032	26,358
Wire	2,350	5,907	9,198
Cable and rope	1,732	4,045	2,734
Netting, fencing and mesh	1,427	3,141	1,570
Other wire manufactures	628	1,100	612
Nails, tacks, etc.	425	1,140	634
Rivets and washers	659	1,327	1,422
Wood screws	389	959	418
Bolts, nuts and metal screws	1,359	3,332	2,928
Stoves, grates, etc. (excl. gas)	793	1,845	1,167
Do., gas	243	530	357
Sanitary cisterns	87	230	468
Fencing material	137	403	854
Anchors, etc.	540	1,331	1,056
Chains, etc.	685	1,379	1,048
Springs	483	864	656
Hollow-ware	4,396	13,455	1,784
All other manufactures	14,720	36,263	35,467
Total	128,109	292,643	319,312

* The figures for 1938 are not completely comparable with those for subsequent years.

THE MODERN PIG

IF YOU WANT...
clean iron, free from sand, free from sows ...uniform analysis... convenient size...easy handling... specify
STANTON MACHINE CAST PIG IRON

SPECIFICATION

WEIGHT	80-90 lbs.
Length	22 inches
Width	8½ inches
Thickness	3¾ inches

(at notch 2¼ inches).

Made in our well-known
STANTON, HOLWELL & RIXONS BRANDS

THE STANTON IRONWORKS COMPANY LIMITED NEAR NOTTINGHAM

Company News

(Figures for previous year in brackets.)

Federated Foundries—Dividend of 5% (3¼%).

Moss Gear Company—Interim dividend of 7½% (same).

Associated Engineering Holdings—Interim dividend of 7½%.

A. C. Cossor—No interim dividend for the year ending March 31 (6%).

Aero & Motor Aluminium Castings—Interim dividend of 12½% (7½%).

Bede Metal & Chemical Company—Final dividend of 12½%, making 18¾% (9¼%).

P. B. Cow & Company—Final dividend of 17½%, making 30%. The company was made public in July, 1947.

Woodhouse & Rixson—Net profit for 1947 after taxation, £15,009; dividend of 10d. per unit; forward, £32,865 (£27,023).

Charles Clifford & Son—Second interim dividend of 2s. 6d. per share, tax free, making 3s. 6d. per share (same). No final dividend will be recommended.

Wake & Dean—Interim dividend of 4% (2%). The board states that the increased payment should not be taken as indicative of an increased total distribution for the year.

Beans Industries—Net profit, after tax, etc., for the year ended November 30, 1947, £37,063 (£42,407); to general reserve, £10,000 (same); dividend of 37½% (same); forward, £40,405 (£36,992).

Fescol—Profit for 1947, £9,248 (£11,971); to general reserve, £220 (£3,086); reserve against fuel crisis stoppage losses, nil (£3,000); dividend of 50% and bonus of 25% (same); forward, £18,997 (£14,147).

Wildt & Company—Net profit for 1947, after depreciation, etc., £110,065 (loss £32,064); amounts previously appropriated from profits, nil (£8,164); to income tax, £19,326 (nil); profits tax, £19,795 (nil); dividend of 50% (nil); forward, £41,251 (£11,832).

Lehmann, Archer & Lane—Profit to November 30, 1947, £143,972 (£128,753); credit applicable to previous year, £1,854 (£1,227); to depreciation, £13,691 (£4,650); directors' remuneration, £16,719 (£21,917); taxation, £66,700 (£69,310); final dividend of 75%, making 100%; forward, £71,091 (£49,876).

Radiation—Aggregate profits of subsidiaries for 1947, £651,047 (£581,761); to tax, £337,024 (£295,783); net balance, £314,023 (£285,978); transferred to parent company, net, £191,463 (£162,296); transfer fees and bank interest, £192,084 (£162,870); dividend of 12½% (10%); forward, £163,516 (£162,084).

Westwood, Dawes & Company—Trading profit for 1947, £30,199 (£22,738); to directors' fees, £200 (same); depreciation, £3,213 (£2,378); tax, £14,000 (£11,000); deferred repairs, nil (£500); net profit, £12,785 (£8,660); to general reserve, £5,000 (same); dividend of 20% (15%); forward, £9,988 (£7,702).

British Engine Boiler & Electrical Insurance Company—Premium income, etc., for 1947, £1,297,720 (£1,044,720); claims and outgoings, £1,078,594 (£921,924); credited to profit and loss account, £117,926 (£80,783); final dividend of 17s., making 34s. (same) per £5 share; forward, £343,433 (£300,974).

P. & W. Maclellan—Profit for 1947, after tax and contingencies, £62,938 (£60,404); to directors' fees, £2,500 (same); debenture interest, £6,561 (same); depreciation, £10,000 (same); deferred repairs, £2,200 (£4,000); pensions, £6,000 (nil); reserve, £10,000 (same); dividend of 7% (same); forward, £14,412 (£12,674).

R.F.D. Company—Trading profit and dividend receivable from subsidiary company for 1947, £15,831; income tax and E.P.T. recoverable, £2,000, interest and transfer fees, £99; (previous year net trading loss, £31,254); to depreciation, £5,570 (£3,857); bank interest, £1,625 (nil); dividend of 8% (10%); forward, £7,802 (£4,472).

Evered & Company—Accounts for 1947 show balance available, after transferring £20,000 to plant replacement reserve and £10,000 to stock reserve, £63,241 (£41,195); dividend of 15% (same) and silver jubilee bonus of 5%; to general reserve, £25,000 (same); reserve for research, £20,000 (nil); forward, £23,231 (£24,521).

John C. Parkes & Sons—Net profit for 1947, after tax, etc., £13,938 (£12,235); transfer fees, £8 (£6); to general reserve, £5,000 (£3,000); building reserve, £3,000 (same); debenture interest, £1,519 (£1,491); final dividend of 1s. per share and bonus of 6d. per share, making 2s. on the 15s. shares (same); forward, £20,621 (£18,557).

Lancashire Dynamo & Crypto—Profit for 1947, after tax, etc., £126,715 (£107,446); to depreciation, £19,960 (£12,839); directors' fees, £2,630 (£2,225); net profit, £104,125 (£92,382); final dividend of 10% (same) and bonus of 7½% (same), making 22½% (same); to pension fund, nil (£3,000); general reserve, £9,112 (nil); forward, £206,991 (£173,193).

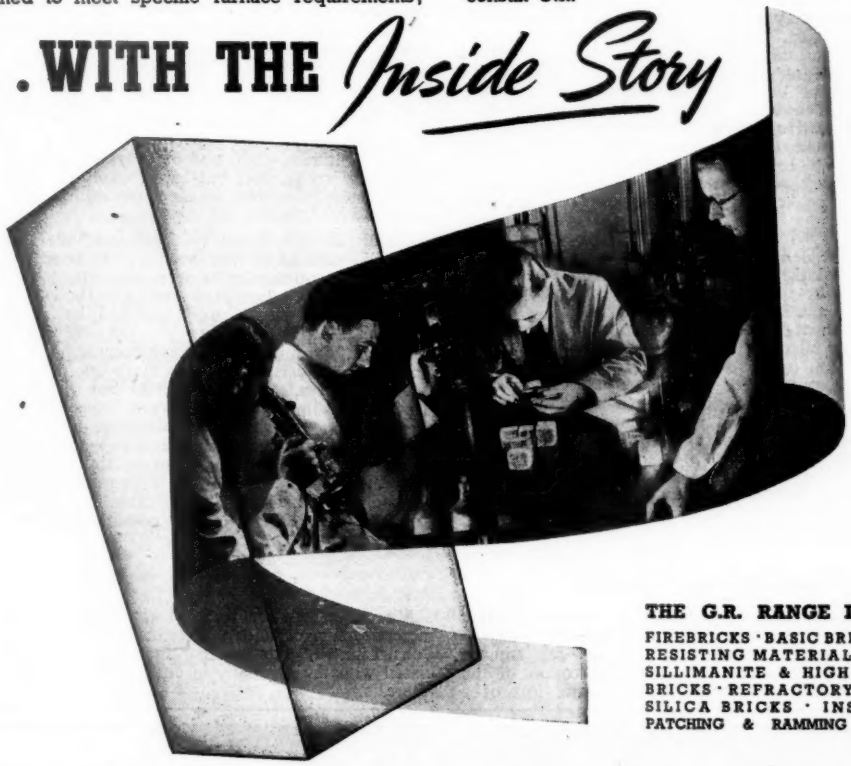
Richard Lloyd—Net profit for 1947, after tax, etc., £22,220 (£21,103); transfer from special reserve, £3,125; dividend of 1s. per share (same) and further dividend of 2½d. per share, tax free, out of special reserve (interest on tax reserve certificates); to research and development reserve, £10,000 (nil); special reserve, £286 (£242); contingency reserve, nil (£10,000); forward, £17,427 (£15,332).

J. & E. Hall—Trading profit for the year to September 30, 1947, £280,612 (£225,922); to depreciation, £34,177 (£32,210); extra depreciation equal to gross amount of initial allowances granted under Income Tax Act, 1945, £29,105 (nil); income from investments, £2,014 (£2,490); profit on realisation of investments, nil (£7,848); reserve against loan not required, £2,000 (£2,500); to taxation, £123,000 (£120,000); bank interest, £6,334 (£6,922); stamp duty on authorised capital increase, £1,000 (nil); net profit, £65,333 (£55,772); provision for pension scheme not required. £1,366 (nil); dividend of 10% (same); forward, £162,851 (£137,072).

FURNACE LINING ECONOMY BEGINS

That G.R. products are widely used because they can be depended upon to provide strong, stable and lasting furnace structures and linings, is due to the foresight and the exceptional care taken in manufacture, development and research. Whether Basic, Silica, Fireclay or any other type of refractory material, the G.R. range is so wide that the correct choice is always possible. Each type is designed to meet specific furnace requirements; manufacturing processes employing the latest in plant and equipment are developed to maintain uniform quality at standards which G.R. research maintains at the highest level of efficiency. These activities are all directed by a comprehensive practical knowledge of furnace conditions. That is why for the finest refractories and sound technical assistance it always pays to consult G.R.

. . . WITH THE *Inside Story*



THE G.R. RANGE INCLUDES

FIREBRICKS · BASIC BRICKS · ACID RESISTING MATERIALS · SANDS SILLIMANITE & HIGH ALUMINA BRICKS · REFRACTORY CEMENTS SILICA BRICKS · INSULATION PATCHING & RAMMING MATERIALS

GENERAL REFRACTORIES
LIMITED

GENEFAX HOUSE, SHEFFIELD, 10. TELEPHONE · SHEFFIELD 31113

Raw Material Markets

Iron and Steel

Amply supplied with coke and iron ore, blast furnacemen have now approximately reached the target output figure. But this is still not sufficient, particularly for foundries, and, as these establishments have a big volume of export orders in hand, as well as heavy requisitions for castings required by home industries engaged in the export trade, their requirements cannot be neglected. The demand for foundry iron has undoubtedly been swollen by the scarcity of cast-iron scrap, and it is hoped that one or more additional blast furnaces may shortly be put into commission to cater for this need. Meanwhile, licences are only issued after careful scrutiny, so that current supplies are used to the best advantage.

One effect of the excessive demand for steel has been to extend consumer interest in finished iron. Most of the prospective output of bars has already been sold to the end of June, and regular inquiries are coming to hand for additional tonnages.

The undiminished interest displayed by re-rollers in crops and defectives implies that they are not too well placed for prime billets and sheet bars. Nevertheless, the position is a little easier. There has been some expansion in the deliveries of home-produced semis, notably slabs and the larger-sized billets, and bigger consignments of Belgian semis are expected shortly under the terms of a new trade agreement.

Cancellation of M form authorisations this week will not cause any interruption at the rolling mills, as plenty of the new I.S. order forms are already at hand. So far as can be ascertained, shipbuilders' allowances have not been cut, and bigger tonnages than ever are being allocated to the collieries, power-plant producers, and agricultural-implement makers. Strip and wire mills are working under heavy pressure and, even at the cost of limiting supplies of rails, chairs, etc., to the home railways, bigger tonnages are being diverted to destinations overseas.

Non-ferrous Metals

The quiet spell experienced over the Easter holidays had no effect on the firm tone which prevails to-day in non-ferrous metals. The sterling prices for copper, lead and zinc are, of course, only a reflection of the quotations ruling in New York, plus some sort of a profit margin which the Government sees fit to impose upon consumers, but the course of scrap prices is dictated by a rather different set of circumstances and is the nearest approach to-day to a free market in the United Kingdom. While the relationship of supply and demand may be the main cause of alterations in value in secondary metals, changes have been seen, and doubtless will be seen again, due to anticipated movement in the virgin metal quotations. In the second half of last year, for example, something very like panic seized the scrap market in Britain, which was sold down to a point when the margin between old and new metal became very wide indeed. All this happened because holders thought that the Ministry of Supply would reduce their quotations, but, apart from a token drop of £5 per ton in copper, nothing happened, and in due course there was a recovery which eventually restored scrap prices to the level obtaining before the downward drive began. Actually, what happened was that the U.K. scrap market declined, due to fears regarding the price structure, and it is worth remembering that in the middle of last year copper was selling very cheaply on the Continent. Nor was the warning given by scrap altogether wrong, for, but for stockpiling by the U.S. Government, the chances are that values in America would have fallen.

March, the first month to come under the 7 per cent. reduction scheme of the Ministry of Supply, is now past and it remains to be seen what the total for the month will be. February certainly showed a sharp drop compared with January, and had the consumption figure of 28,939 tons been the opening tonnage for the year, there might never have been any cut in usage. The decline is certainly a very sharp one, and owing to Easter holidays, it is possible that last month will not show much improvement. Scrap usage in February was 16,781 tons, which is an increase on the January total. This movement in the scrap tonnage, which appears to be in inverse ratio to the change in the virgin-metal figure, is in some ways rather inexplicable, but there cannot be much doubt that a correct estimate of the statistical trend is only possible if taken over a period of about three months.

MR. A. B. STOBART has been appointed assistant commercial manager and a director of John Summers & Sons, Limited. For the last 10 years he has been associated with the company in connection with its foreign interests.